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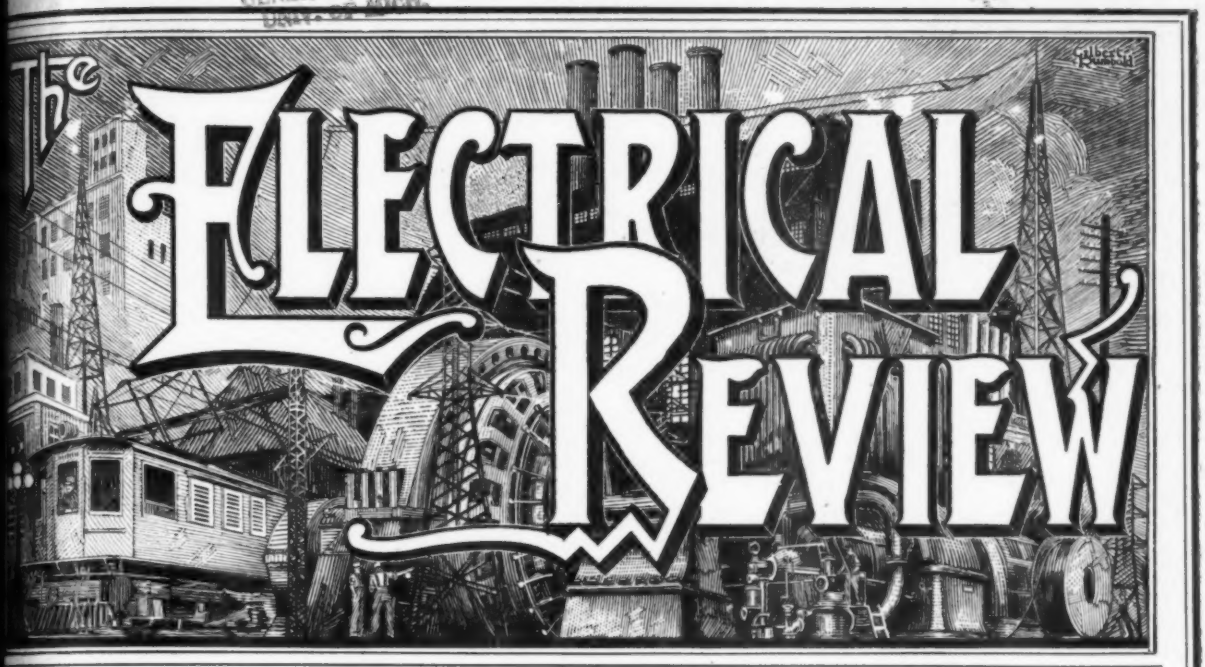

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ELECTRICAL REVIEW.

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SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "London Joint City & Midland Bank, Newgate Street Branch."

THE ELECTRICITY COMMISSIONERS' REPORT.

A CERTAIN proportion of the report now just issued and covering the year ending March 31st is concerned with information and data already circulated. But it is none the less welcome in permanent and handy form, especially as there are added thereto some general observations of the Electricity Commissioners which are of a good deal of value. The Commissioners are in a unique position to judge of the general progress of the industry, its outstanding tendencies, and the main lines on which it promises to develop. Any considered statements, therefore, such as are contained in the present report serve very useful purposes to all parties. Investors and the public generally have here something on which they can rely, solid fact and disinterested judgment by which they can let themselves be safely guided. The individual undertakers can get a bird's-eye view of a whole year's working of the industry. They can pick up many useful hints and indications which may be useful to them in guiding their individual policy. Moreover, the reassuring record in the report will give them increased confidence in the future of the industry, and above all, it may be that laggards and do-nothings will be stimulated into some sort of activity by realising some of the potentialities that lie in their grasp.

Electrical enterprise is broadly witnessed to by the number of Special Orders applied for (namely, 67) and the nature of some of them, also in a less degree by the 59 Fringe Orders granted and by the new generating plant authorised during the year, namely, 375,609 kW, being 173,007 kW for local authorities and 202,602 kW for companies. The headway made is shown by a comparison with the previous year, when only 164,032 kW was sanctioned.

The increase in output, *viz.*, 17½ per cent., and the coal economies effected were fully dealt with in the recent report dealing in detail with the generation of electricity in the United Kingdom. As regards schemes, the progress here is somewhat limited, but the Commissioners strike a hopeful note when referring to the Special Orders mentioned above and to the fact that "many of the applications emanated from authorised undertakers and other bodies in the various Electricity Districts which have been provisionally or finally determined," and they point out the satisfactory results to which such incidental reorganisation will lead. This gradual process of reorganisation is also attested to by the table showing the undertakings which have linked up for bulk supplies or reciprocal supply—of which there are 110 local authority undertakings and 64 company undertakings.

These are only a few of the salient features of the report, which is worth the careful perusal of everyone engaged in the administrative side of the industry.

We note with much satisfaction the intimation that certain other records are in preparation. The value and utility of comprehensive data cannot be overestimated, and the industry is fortunate in the systematic way in which these records have been and are being taken in hand.

One publication which is promised is a complete list of local authorities and companies holding statutory powers, together with details of areas of supply, maximum prices, terms and dates of purchase rights, and so forth.

Another publication which is under consideration is a record of all the non-statutory undertakings, and also of all generating plant installed in Great Britain. The Commissioners point out the valuable assistance which the latter would afford when the question of reorganisation of electricity supply was being dealt with, since the record would show "the potential demand for industrial purposes in the event of public supplies being made available at sufficiently favourable rates." In other words, there would be a list of private plants waiting to be thrown out, a list which ought to be at once a challenge and an incentive to undertakings.

That there is almost unlimited scope in this direction is shown in the statement in another part of the report that in one Electricity District the private generating plant installed in collieries and other industrial works largely exceeded the total capacity of the plant installed by the whole of the authorised undertakers in the district. We note, too, the gentle way in which the Commissioners rub in their watchword to undertakers—"Co-operate!" They reiterate that this is the way to attain the "gradual discarding of much of the private generating plant at present in operation." Again, that "the possible economies (in generation, &c.) will be largely dependent upon the extent to which the authorised undertakers in a district are prepared to co-operate in the centralisation of generation, in the pooling of the resources of interconnected stations for the common good, and in discontinuing the use of relatively inefficient or badly-placed stations." The comment on this by a certain number will be: "We have heard all this before." But none the less we think there cannot be too frequent a reiteration until the happy time arrives when it is taken to heart.

Altogether we think the report redounds greatly to the credit of the Electricity Commissioners and their staff, and merits a most appreciative reception by the industry. In January last we published an abstract of their report for 1921-22; the arrival of the report for the year ending on March 31st, 1923, six months after that date indicates that, as in the case of the fuel consumption returns which we summarised a month ago, the Commissioners have succeeded in materially accelerating the execution of this important part of their work, and congratulations are due to them and their staff on the result.

The Coming Exhibition.

It is very satisfactory to learn that the recent rate of progress in space-letting for the Electrical and Allied Section of the British Empire Exhibition has been such that 94 per cent. of the space allotted to the B.E.A.M.A. has been let. The mention of this figure should induce those electrical firms who have not made their requirements known to make haste and secure their share of the remaining six per cent. of accommodation. We wish to repeat here our strong recommendation to the smaller firms who have not yet made plans to participate because of the cost of running a six-months' stand involving personal attendance, that they seriously consider the advisability of taking advantage of the means that have been prepared by the management to meet their special case. It is possible for, say, £150, to have an exhibit taking the form of a showcase which, with its contents, will be cared for and supervised by the B.E.A.M.A. staff, who will undertake to forward daily such letters or inquiries as are received at the exhibit. In view of the increasing interest that smaller firms have been taking during the past few weeks, it should not be long before the space order books are closed. Then everything should be plain sailing for the management to make headway with detailed arrangements and for the exhibitors to develop their plans for making effective displays of their products.

The excellent scheme of the Electrical Development Association for the popular demonstration in the Palace of Electricity promises to be a success, for the funds forthcoming from many electricity supply authorities amount in the aggregate to a very substantial figure. It passes our comprehension, however, why the electricity supply companies, especially those in the metropolitan area who naturally stand to gain more than anybody else from so fine a piece of electrical propaganda work, should be so backward in rendering substantial financial support. There is something about their attitude that we fail to understand. As our readers well know, the companies have been doing well, paying high dividends, and recording high market prices for their shares; they have a prospect that their tenure will be extended for forty years and that funds placed aside for the 1931 possibilities will not be needed for many years to come; yet they fail to respond generously to an appeal for funds to assist in the future development of their own businesses. This display, coupled with more reasonable charges to consumers, should contribute to a big forward movement, bringing them thousands of additional consumers and securing a greater all-round electrical prosperity. We hope they will do their bit and thus avoid unpopularity.

The World Power Conference.

We have now received further official information with regard to the First World Power Conference which will be held at Wembley from June 30th to July 12th, 1924, under the presidency of the Earl of Derby. Our readers will remember, from matter already published, that it has been promoted by the B.E.A.M.A. in co-operation with technical and scientific institutions and industrial organisations in Great Britain and other countries. A lengthy list lies before us, giving the particulars of countries that are participating and the national committees which will represent them. It is an impressive list, and suggests that the occasion will not only be a great event, but that it will be unique. There have been sectional engineering or scientific conferences in many parts of the world, but nothing quite so comprehensive as is indicated by the plans that have been developed for next summer. The classified programme which is available in detail has five main divisions devoted to: (1) power resources; (2) power production; (3) power distribution; (4) power utilisation; and (5) general. The papers to be read will number between 150 and 200, and the reader may look forward to a feast of power literature suited to every conceivable taste. We publish elsewhere in this issue a list of the papers that have been arranged for down to date by the British National Committee and of the subjects that are at present under consideration.

Liverpool Tramways Success.

The year 1922-23 was a good one for both electricity supply and tramway undertakings. Among the latter many turned deficits into profits, notably the London County Council, Leeds, and Leicester, while many others improved upon the results of past years.

One of the most remarkable changes occurred in the position of Liverpool, the accounts of which undertaking are summarised in this issue. From the report, it is seen that a deficit of £81,652 incurred in the two preceding years was wiped out, with £174,132 to spare.

In such a case it is natural to look for the extraordinary circumstances which caused a change-over of this magnitude, but having examined the report, we are forced to conclude that the successful result was due to nothing else but steady working. The revenue has not increased to an inordinate extent, nor has the working expenditure been drastically cut down. Nevertheless, between the two the difference has widened so that the ratio of expenses to receipts has fallen from about 95 to 81 per cent. The example of Liverpool is but another addition to the accumulating testimony to the efficiency of tramway systems in large cities.

Before dropping the subject we would say something regarding the accountancy. We cannot agree that the deduction of past deficits from the current profit gives a *net* profit for the year. While it is purely a "paper"

matter, it tends to detract from the impression of success gained by a casual reader of the summary of results; in this case it makes a difference of £81,652, not a trifling amount by any means. Then in the same summary the ratio of £1,506,046 (working expenses in 1921) to £1,558,907 (revenue) is given as 83.4 per cent. The ratio for the period of the report is shown, correctly, as 81.1 per cent. This appears to be a good but not extraordinary improvement, but actually the 1921 percentage was about 96—the comparison of the true figures tells quite a different story. Yet another point is that a gross profit of £52,860 (1921) is shown as 10.2 per cent. on a capital of £2,178,955; printers sometimes move decimal points, but their innocence proclaims itself in this instance.

The E.T.B.I. Festival.

Once more we are within hail of the date when the annual Festival of the Electrical Trades Benevolent Institution will be held; this year Sir Philip Nash, K.C.M.G., C.B., chairman of the Metropolitan-Vickers Electrical Co., Ltd., will preside at the Festival, which is to take place on Wednesday, November 14th, and in a letter of appeal which he has issued he briefly sets forth the needs and aims of the Institution. At present the income from investments is under £800 a year, so that the granting of pensions—the principal object of the E.T.B.I.—can as yet be done on only a very restricted scale. We trust that our readers will realise that it is the duty of all who belong to the electrical trade and industry to give something towards the maintenance of those fellow members of it who fall by the wayside and are unable to provide for themselves.

International Arbitration in Commercial Disputes.

Some months ago we referred to the official inauguration in Paris of the International Court of Arbitration, which had been organised by the International Chamber of Commerce in Paris. The scope of the court, which is a purely private undertaking that seeks to pledge the members of chambers of commerce which are affiliated with the International Chamber in Paris to submit any disputes which may arise to the decision of the International court, has also been set forth in detail in an earlier issue of this journal. It is, however, advisable to recall the fact that in cases where the usual arbitration clause has been inserted in contracts between subjects of different nations and where disputes take place, the services of the court are first available in the form of offering the medium of conciliation for the settlement of opposing interests, and only in the event of failure in this direction is the matter referred to arbitration for final adjustment. This, then, is one of the important differences between the International Court of Arbitration in Paris and the arbitration scheme which has now been approved by the Assembly of the League of Nations at Geneva.

The scheme prepared by the Economic Committee of the League of Nations, which has also been referred to in previous issues of this journal, likewise differs in turn from that of the International Court in Paris in the sense that it becomes compulsory on the member States which ratify the Protocol, which applies solely to arbitration. The principal clause runs as follows:—"Each of the contracting States recognises the validity of an agreement, whether relating to existing or future differences between parties subject respectively to the jurisdiction of different contracting States by which the parties to a contract agree to submit to arbitration all or any differences that may arise in connection with such contract relating to commercial matters, or to any other matter capable of settlement by arbitration, whether or not the arbitration is to take place in a country to whose jurisdiction none of the parties is subject." The final text of the Protocol appears in the *Board of Trade Journal* of October 4th, which should be studied by those who desire further information. The Protocol has already been signed by certain States, including Great Britain, and it will come into force as soon as two ratifications have been deposited with the Secretary-General of the League of Nations.

The Powers of the P.M.G.

Elsewhere in this issue we print the reply of a Post Office engineer to the article by Mr. W. H. Stoker, K.C., which appeared in our issue of September 28th. The questions which have been raised are of great importance to engineers engaged in the public supply of electricity, as well as to many others who are responsible for the design and erection of electric mains, whether overhead or underground. The value of the discussion which has been opened in our columns will depend largely upon the degree of interest displayed by our readers; if they are content to be onlookers only, the matter will very soon lapse into oblivion. If, on the other hand, they wish to have it thoroughly thrashed out, it is for them to take action, and our "Correspondence" columns are at their service for that purpose.

Scientific and Industrial Research.

The annual report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1922-23, which is abstracted elsewhere in this issue, is of a dual character: It is encouraging inasmuch as it affords an indication of the excellent and valuable work that has been, and is being, accomplished, but at the same time it is disappointing because it records the failure to realise the anticipations that were made at the inception of the scheme some eight years ago.

The best research organisations require considerable time to get into full working order; experience has shown that three years must elapse before an investigation of any magnitude can be effectively launched. Had a period of five years' prosperity followed the war, the associations founded before and immediately after the Armistice would probably have established themselves sufficiently to continue their existence during the subsequent period of depression "which all knew must follow." The depression, however, came too soon, the consequence being that few, if any, of the associations have succeeded in establishing themselves on an adequate and independent basis.

Accordingly, although the five years of grant appear to be insufficient to fulfil the original intentions of Parliament in voting the money to establish the Million Fund, the Committee has decided to terminate the present agreements at the close of their currency. But it should be noted that, if any association should apply for further aid, its application will be considered on its merits, and with that end in view it is suggested that an inquiry should be made into the operations of the association. Since the scheme is in the nature of an experiment, such a review of its usefulness is only proper in order to enable conclusions to be drawn as to its success or failure.

It is made perfectly clear that no further financial assistance will be forthcoming under any conditions at the termination of any new contract, but it should be remembered that the object of the Million Fund was to provide urgently needed aid, and the money was obviously intended to be expended during the five years following the establishment of the fund. But it appears that during six years only a quarter of a million has been spent, at which rate there may still be a balance in hand some 24 years hence, an obviously ridiculous state of affairs.

Notwithstanding the fact that a substantial amount of the £721,505 balance of the Fund will be needed to complete the payment of grants to existing associations during the remainder of their quinquennial grant periods, and that allowance must also be made for new associations that may be formed, it would appear as though the Fund could have been administered in a manner which would have afforded more liberal assistance than seems to have been granted.

WATER-POWER STUDIES.—VI.*

Rainfall and Run-off.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E., M.Am.Soc.C.E.

The causes of precipitation over most catchment areas are quite complex and varied. For instance, it is not uncommon to find rainfall occurring on one side of a valley, while the opposite slopes are receiving little or none at all, or, perhaps, brilliant sunshine. Moreover, the many varied features of catchment areas amply show the necessity for complete meteorological information in every case where accurate estimates are to be obtained for the water run-off and stream flow for power purposes.

The extent of stream flow from a catchment area depends primarily upon the total area of the basin drained, the depth of rainfall (total precipitation, such as the elements of rain, snow, &c.), the geological formation, the topographical features, as also on the general characteristics of the area. That the catchment areas of equivalent size give little relationship as to the actual run-off or stream flow is undeniable, because the watersheds may vary, and do vary, to the extent of two opposite extremes, as, for instance, from glaciers and snowfields of mountain ranges to the arid region of a dry belt. Hence, the same conditions of power development cannot be expected from two streams differently situated, &c. The average time-period of peak flood will also depend largely upon the topography and upon the elevations within the catchments and the mean latitude of these catchments. Where the catchment includes a large area of high mountains, some of the winter precipitation may be stored in the form of snow, which later in the season contributes to the spring freshet. The greatest floods of the year (in certain countries) occur when a spell of warmer weather, combined with heavy rain, causes excessive melting of the snow. It is recognised that neither catchment areas nor water areas, nor, in general, average differences of elevation over considerable distances have, necessarily, any specially significant bearing upon estimates of the amount of available water power. That is, the presence of natural reservoirs do not necessarily imply the existence of considerable water power; extensive water areas may, nevertheless, provide good reservoirs where water may be effectively impounded, and, indirectly, water is very often of much greater value to a water power receiving direct benefit from such storage than water power without storage. In any case, if we desire to turn these extensive water areas into producers of power, head is required.

It is generally accepted that forests receive a greater quantity of rain, snow, and hail than open land in the same vicinity; that mountainous areas, whether bare or covered with forest growth, receive more rain than flat and low-lying country; that forests in mountainous areas receive more rain than open land at the same elevation; that the effect of mountainous districts is to cause the rain which falls on them to be more equally distributed, both throughout the seasons and from year to year; and that a local excessive rainfall may probably be due chiefly to a precipitous face of a projection from high mountains which tends to arrest and condense the current of moist air.

While the records of run-off from a catchment area are of first importance in the question of water-power development, the rainfall is also of extreme value, in that these latter records—if of a more extensive period than those of the run-off—would indicate the high and low range of flow which might be expected. An additional check may be had from an examination of the annual rings of good sized trees in the catchment area. Another is that rainfall records of a catchment area, in which no discharge measurements are available, can sometimes be used for the estimation of the stream flow based on the rainfall and run-off records of an adjacent catchment are of approximately similar dimensions and characteristics.

Calculations for available power depend primarily, not upon total precipitation or rainfall, although this is the original source, but upon the flow of the particular stream under investigation. If the daily flow of the stream is known for a long and continuous period or for a period of, say, seven or more years, which includes the severest drought, it would be possible by plotting these records to lay down a line of power demand representing a quantity which it is desired to obtain from the catchment area and to scale off directly the approximate power and the storage necessary to provide for that demand which may quite likely represent the estimated flow for maximum development. Of course, the more reliable method is always to deal with stream gauging in preference to collection of rainfall data, as stream gauging is always very much more important and more reliable than rain gauging. As a matter of fact, it is from the discharge of the stream that the available quantity of water is found, not from the total precipitation (rain, hail, and snow) which is naturally influenced by all sorts of complex conditions before it actually reaches the streams. Moreover, the relative run-off is also made subject to a coefficient value dependent very largely on the "personal equation." Usually the investigating engineer is more directly interested in the rate at which the run-off occurs and in the quantity thereof in a time-period, *i.e.*, given percentage of time for given amount.

Although it is found quite practical to establish a useful relation, expressing *probability*, between the run-off and the rainfall, it is quite impossible to define or fix a law which can be relied upon to give this relation with accuracy for each year and to suit every size and character of catchment. For instance, if we consider only the same aggregate for one year in the same area, we may find that the rainfall has been concentrated in a few storms of great intensity, while in another year the rainfall has been distributed over a great number of storms with barely enough rain to saturate the surface soil and with sufficient intervals between storms to permit the soil to lose its water by evaporation. Thus, in the former case a relatively large proportion of the rain will find its way into the stream, whereas in the latter case very little, if any, run-off will occur, although approximately the same amount of rainfall may be recorded. Further, it is impossible for any one to predict the rainfall as to time and quantity for future years except on the basis of past records, and it is principally with this unalterable limitation on *estimated* water yield and *estimated* maximum and minimum flow that the relation of run-off to rainfall should be studied. Furthermore, in the study of rainfall intensity applying to any catchment area, it follows that even in the case of the very best-located rain-gauge stations only an approximation of the actual rainfall can be recorded. Some of the reasons for this are:—(1) Each rain-gauge record is only an approximation of what occurs on and, perhaps, a few yards away from the station; (2) maximum rates of rainfall during a storm at various points in a catchment area do not occur at exactly the same time; (3) distribution of rainfall is not the same in all places nor for all storms: (4) a rain gauge records only what happens at the particular point where it is placed; (5) the maximum possible storm may not be among the particular storms which have been recorded, &c. For catchment areas of considerable extent, the relation of run-off to rainfall is further com-

* Previous articles in this series appeared in the Electrical Review of February 2nd and 9th, March 16th and 23rd, June 15th and 22nd, July 13th and 20th, and August 17th and 24th, 1923.

plicated by the difficulty always encountered in the determination of total precipitation as well as by the lack of precision in the estimates of stream flow. The principal elements of uncertainty are snow, hail, rain, and so forth, and only the crudest kind of approximation is often resorted to—the personal equation again predominating with regard to choice of a reliable coefficient. It is suggested that, in order to get a more reliable estimate of the annual precipitation upon a catchment area by the ordinary rain-gauge method, there should be one rain gauge to about every 0.75 to 1.0 sq. mile.

The value of forest and scrub in condensing moisture and the effect of irrigation with its crops in producing or slightly increasing rainfall is not generally disputed. The air over ground covered with forest, scrub, or green crops—protected from the direct rays of the sun—is much cooler than it is over country not so covered, and therefore is able to condense the heated and saturated air, causing steady rainfall. The heated air over bare country cannot condense the moist air, which rises, causing violent downpours of rain, finally resulting in the best sloping land being stripped of its soil. In China, India, and other parts of the world, vast areas of the uplands are quite denuded of soil owing to the lack of covered ground and the resultant destructive storms. A scoured and deforested area which has lost the humus of its soil cannot hold the rains, which, instead of being retained in the ground and transmitted into plants by the various processes of growth, carry destruction in their pathways. Investigations seem to have proved that, with the introduction of forest growth, rainfall that has ceased may be made to start again and, by hastening most kinds of tree growth on desirable catchment areas, it is likely that rainfall will be increased and be made more regular.

Evaporation from the soil surface is dependent upon the same factors as control evaporation from water surface, and, in addition, it is dependent on the degree of saturation of the soil surface. The amount of evaporation from water surfaces is mainly controlled by temperature, humidity, and wind velocity. Wind velocity generally tends to increase with elevation. With a large surface area the total evaporation will be slightly greater in proportion than for a small surface area. The direct evaporation loss during heavy rains is usually only a very small proportion of the available water supply. One of the important factors affecting evaporation losses of all kinds is temperature. As the result of experiments on evaporation, it has been found that evaporation from flowing water is about 8 per cent. greater than from still water, all other factors being equal, and that an increase in water temperature produces practically corresponding increases in evaporation. Temperature is also an important factor in relation to floods as affecting the rate of melting of accumulated snow. According to locality and climate, evaporation per annum from the water surface of reservoirs varies from about two to ten feet—six feet has been recorded by the writer in East Africa.

If the rainfall for a given year is very little, the time during which the soil is wet and evaporation rapid will be short; consequently, in such years evaporation will take less of the rainwater than it will in wet years. If, however, the number of rainy days is great, and the conditions favouring evaporation (by reason of the long time during which the atmosphere is saturated) are poor, then, even with a saturated condition of surface soils, there may be less evaporation than would possibly occur for a fairly regular rainy period of a few days with a dry period of similar duration. Evaporation may therefore take more of the falling water as rain in fairly wet years than in dry years, and the evaporation may take from the soil practically all the water which falls in dry years, when the rainfall is very little, perhaps leaving nothing to go to the stream.

The *probable* ratio of evaporation to rainfall will decrease as the quantity of rain increases up to some more or less definite limit, and, conversely, the proportion of rainwater which reaches the stream as run-off will increase. In the study of stream flow and run-off in a catchment area it is very necessary to look carefully into the relative proportion of water surface formed by lakes, storage, pondage, and the like, and the variation of water surface from one season or one year to the next; this will usually involve the study of loss of water by evaporation. In such catchment areas with a large proportion of water surface, it may be found that when the rainfall is small, the loss of water by evaporation exceeds the accession resulting from rain falling directly on the water; the water production from such an area, *i.e.*, catchment-embracing lakes, &c., of considerable extent, may therefore be a *negative* value.

Evidently, the extent of run-off—surface flow or stream flow—depends principally upon the depth of rainfall and the area and character of the catchment area or basin drained; that is to say, it depends on such features as the geological formation and topography of the catchment area above the power site; proportion of forested, watered, and bare areas; contour of the ground; nature of ground; altitude; climatic conditions, &c. The run-off of any stream varies not only from season to season, but also to such an extent from year to year that the same conditions are not likely to occur in any two successive years. Records for a cycle of *at least* seven years are necessary to cover the yearly variation to be anticipated, but records extending for a period of 30 or more years would certainly be more reliable, although it has, in rare cases, been found that a cycle of five years has given sufficiently reliable results to warrant a power development.

In the determination of the *probable* run-off for various periods for typical years at a given power site, much will depend upon the character of the available records. Unfortunately at the present time few records are, what one might call, complete. In the determination of the most probable run-off a great deal must be left to the judgment of the investigating engineer. It may be found that there are no run-off records, but ample rainfall records of an adjacent catchment area, or there may be no run-off records of the particular power site, but numerous run-off records at stations in the same or in adjacent catchments of similar characteristics. Failing stream flow measurements, the most obvious requirement is to have long-period and continuous run-off records of the actual power site under consideration. Discharge measurements are usually computed—in their final form—in terms of run-off in cusecs or cusecs per square mile of catchment area. It is important that the area of each catchment be obtained as accurately as possible. At these times there is little excuse for not obtaining correct catchment area dimensions, as excellent Ordnance and other maps are now available.

In terms of *average* values of rainfall, catchment area, and head, the available power can be expressed:—

$$\text{H.P.} = 0.00828\ f\ m\ \text{H}$$
$$\text{E.H.P.} = 0.0073\ f\ m\ \text{H}$$
$$\text{kW} = 0.0062\ f\ m\ \text{H}$$

wherein f = average rainfall in inches.
m = catchment area in sq. miles.
H = average head in feet.

For example: The catchment of the Lochaber water-power scheme is 303 sq. miles; the average annual rainfall is 73 in.; and the average head of water available near Fort William is 742 ft. What will be the theoretical power?

$$\text{H.P.} = 0.00828 \times 73 \times 742 = 136{,}000 \text{ h.p.},$$

and, as 1.0 h.p.-year $= 1 \times 8{,}760 \times 0.746 = 6{,}535$ kW-hours, the output (theoretical) would be

$$6{,}535 \times 136{,}000 = 888.76 \textit{ million kW-hours.}$$

The most usual way of calculating the run-off efficiency of the catchment is to divide it into areas on which the rainfall is of uniform amount, and the slopes and general character of the surface are the same. In the measurement of a catchment area it is customary to work it out on the topographical map and to planimeter

the enclosed area or to mark it out by ruling squares to scale. The average yield of each constituent area can then be estimated and the total calculated average yield would then be equal to their sum.

The method to use for a determination of *probable* run-off for a given area, taken at the power site, will depend largely upon the character of the available records, such as long-period or short-period or broken-period records, as the case may be. They will depend on records of the area taken at the power site under consideration, or for an adjacent watershed or parts of different watersheds, and rainfall records in the area or within reasonable distance and at the same or at a different altitude, &c. Some of the methods applicable to the determination of probable run-off are:—

(1) Arrangement of the stream flow records by months in order of dryness, regardless of the year in which they occurred, and their final computation of the probable run-off for an *average* year.

(2) Similar to the above (1), except that average weekly or daily flow should be used in place of the monthly records.

(3) Preparation of daily, weekly, or monthly records in tabular form arranged in order of years, but with the days, weeks, or months arranged in order of dryness; the driest periods are averaged, then the *second* driest periods, then follow the *third* driest periods, and so on, and a computed *average* year is finally obtained.

(4) Preparation of a table with rates of flow in cusecs or cusecs per square mile, arranged in order of years, months, weeks, or days, and a final computation of the *average* discharge for each period (month, week, or day), as desired.

(5) Tabulation of the discharges or corresponding gauge heights, marking for each year of record the total number of days when the flow or gauge height is not greater than the given or desired amount. The run-off for an *average* year is obtained by adding the total number of days for any number of years and finally taking the *mean* amount.

(6) Arrangement of the rates of discharge in order of magnitude for each year, taking the mean value of the maxima, then the *next* lower amount; then follows the *third* lower, and so on down to the desired or given smallest amount; finally a complete *average* year is obtained.

(7) Preparation of a table showing the number of times various rates of flow have occurred during the period of record. The final results are expressed in terms of per cent. values to serve an *average* year, showing the range from the extreme maximum to the minimum rates of flow.

The desired or given amount of flow without storage is usually that of the *ordinary* minimum flow, which amount is ordinarily based on the averages of the minimum flow for the *lowest two* consecutive seven-day periods in each year, over the period for which records are available.*

For the completion of power estimates, it is becoming the practice to also give the *estimated* flow for maximum development, stating how the calculation is made—whether for six, seven, or nine months' flow on the basis of continuous power at a given efficiency. At the present time a six months' period is usually taken, that is—

(8) Arrange the months of each year according to the day of the lowest flow in each—the lowest of the six *high* months being taken as the basic month—the *average* flow of the lowest seven consecutive days in this basic month will determine the maximum for that year. The *averages* of such maxima for all years in the period (for which records are available) is the estimated flow for maximum development.

To be reasonably reliable, formulæ for rainfall must take into account the maximum rainfall, intensity, and time-period, slope and nature of the country drained, as well as other considerations. The run-off is more often expressed as a percentage of the rainfall; that is, by:

$$r' = \text{run-off} = f - E/f \times 100 \text{ (per cent.)}.$$

Wherein f = rainfall in inches.

E = evaporation and seepage losses in inches.

The ratio, total run-off ÷ total rainfall, &c. (or precipitation) cannot be discussed here in detail, as space is not available. Suffice it to say that, considering the factor of run-off only, this factor is influenced by so many complex elements that it is hardly possible to give a general formulæ that will satisfy *all* conditions; in other words, each catchment and each stream is a law unto itself. To express the relationship between rainfall and run-off, or the run-off itself, the following methods have been proposed by various authorities:—

(1) Set out in tabular form or preferably plot curves in terms of a percentage of the total annual run-off, showing the weekly, monthly, or quarterly run-off (as required) to be expected from the given catchment.

(2) By taking 23 in. of rainfall as the amount required to supply the total losses; or

(2*a*) By taking 12 to 18 in. as the amount.

(3) By preparing curves of an exponential formulæ, showing the relationship for storage, growing, and replenishing periods.

(4) Use of annual run-off by an equation consisting of a coefficient, *multiplied* by the square of the annual rainfall, the coefficient varying with slope and mean annual temperature for different catchments.

(5) By taking: $r'' = 0.01\ f^2$ (for f less than 50 in.), and

$$r'' = f - 0.25 \text{ (for } f \text{ greater than 50 in.)},$$

wherein f = total annual rainfall or precipitation in inches on any catchment.

r'' = run-off depth in inches over the same area, resulting from this precipitation.

(6) Use of a constant *plus* a percentage for the several months of the year, varying the relationship on different catchments with the mean annual temperature.

(7) By plotting two *typical* curves, one for streams in mountainous regions and the other for streams draining from broad valleys with gentle slopes.

(8) By taking actual dry-weather flow at, say, 0.25 cusecs per 1,000 acres (1.56 sq. miles) of catchment.

(9) By taking annual run-off in cu. ft. yielded from the catchment as $3.63\ A\ (f - E)$; wherein f = rainfall of a given area in inches; E = losses by evaporation and seepage during the year in inches; M = area of catchment in acres.

(10) By taking the run-off in cusecs yielded from the whole catchment area, as $Q = 200\,m^{\frac{3}{4}}$; wherein m = area of catchment in sq. miles.

(11) By taking run-off in cusecs yielded from the whole catchment area, as $Q = cm^{\frac{3}{4}}$; wherein m = area of catchment in sq. miles; c = 300 to 350 for 6 inches rainfall, 300 for hilly country for a rainfall of 3.5 to 4 in.; and 250 in mixed country, and 200 in flat country.

(12) By taking run-off in cusecs yielded from the whole catchment area, as $Q = 1{,}300\ (m/l^{\frac{1}{3}})$; wherein m = area of catchment in sq. miles; l = length of catchment in miles.

Judging from these different formulæ and proposals, it is seen that, in general, they were devised to represent run-off conditions at some particular locality, and within certain limiting ranges of slope, area, rainfall, and imperviousness. These different proposals do not, by any means, include all the formulæ, &c., proposed. Nevertheless, when all of them are brought together, it is surprising to note that there still exists a great need for a formula of general application which can be used in a "*new*" locality with some reasonable assurance that it will be fairly reliable, will be applicable for large or small areas, flat or steep slopes, heavy or light rainfall, and imperviousness of ground.

*Throughout the Dominion of Canada power estimates are based on this amount for 24-hour power at 80 per cent. efficiency.

THE OPERATION OF POLYPHASE MOTORS FROM A SINGLE-PHASE SUPPLY.

By G. WINDRED.

It is generally assumed that to operate a polyphase motor it is imperative to have a polyphase supply. This is not always correct, however, as it is a comparatively simple matter to run such motors with single-phase current. When operated in this manner, the polyphase machine naturally assumes some new characteristics, the majority of which are inferior to those of the polyphase motor proper, but are sufficiently superior to single-phase working to recommend this system where only a single-phase supply is available or where the application of polyphase machines presents difficulties, as in certain railway work where the

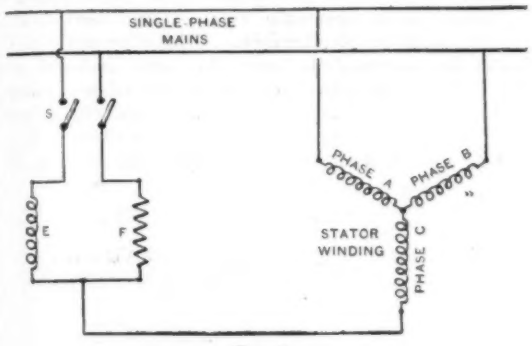

FIG. 1.

elimination of extra conductors represents a considerable saving of money, and sometimes avoids very awkward constructional work.

Examples of the operation of three-phase wound motors from a single-phase supply are fairly common in practice, and the methods employed do not differ very materially from each other. A circuit which is often met with in this direction is shown in fig. 1. Two phases of the motor winding, A and B, are connected in series across the mains, while the terminal of the other phase (C) is connected to a point which is formed by the junction of an inductance and a resistance connected in

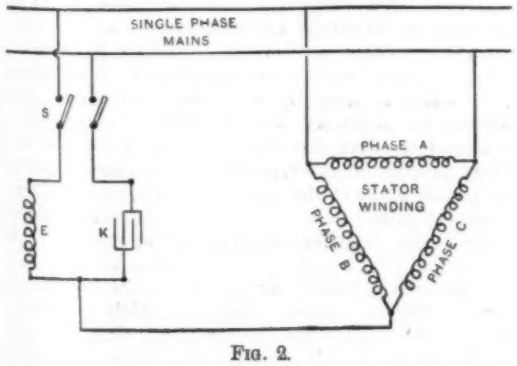

FIG. 2.

series, which are also connected to the mains in the manner shown. When the motor has run up to speed, the switch S is opened, thereby disconnecting the inductance and resistance, together with phase C of the motor winding, and leaving the phases A and B operative for normal running.

A similar scheme of connections suitable for a delta-connected winding is shown in fig. 2. Here, however, a condenser is introduced in place of the original resistance, and, with the inductance, remains in circuit while the motor is running, as otherwise only phase A of the winding would be effective.

Another method, which employs a compensator and a condenser, is given in fig. 3. Two terminals of the motor are connected to the mains, while the third terminal is taken to either of the mains through a suitable tapping of the compensator (M). The condenser is connected to the high-potential terminals of the compensator, and the two are always kept in circuit, as under these conditions a higher power factor and efficiency are obtained, which more than compensate for the losses in the transformer winding.

An arrangement employing a starter of the throw-over type, which has been employed by some firms

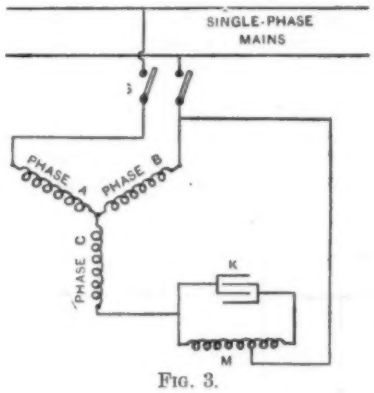

FIG. 3.

supplying ordinary three-phase motors for use on single-phase circuits, but gives inferior results compared with the methods already described, is shown in fig. 4. At starting, phase A is connected to points of the compensator (M) previously determined, while phase B is short-circuited; phase C is inoperative both at starting or running, and the windings of this phase may be omitted. For normal running, phases A and B are connected in series across the mains. The use of a compensator is to subdue the very heavy starting cur-

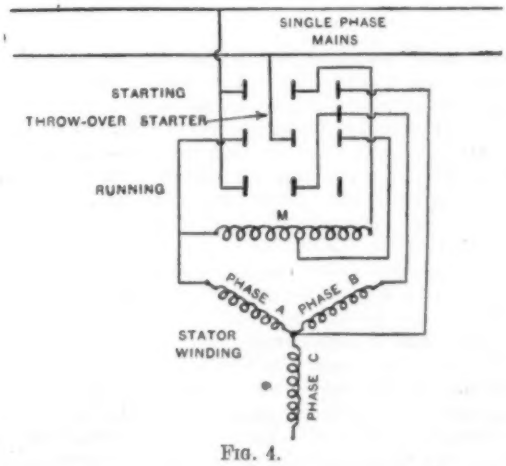

FIG. 4.

rent, which is an inherent feature with these connections, but with the smaller machines this precaution is often omitted. In the smaller sizes of motors, squirrel-cage rotors are sometimes used, but it is much better to use a wound rotor with slip-rings, and to insert resistances in the rotor circuits at starting. Only a very weak starting torque is obtained, and the no-load current is also high, while the power factor, even when the motor is running at its rated load, is rather low. On the other hand, quite good results have been obtained with motors running as shown in the diagram,

fig. 3, a 220-V, 100-cycle, 6-pole motor, rated at 1 h.p., giving the following results:—

With normal terminal voltage, 14 per cent. of full-load torque was obtained. At rated h.p.-output, the efficiency was 66 per cent. and the power factor .54. The removal of the condenser effected an appreciable reduction in both these figures, as the efficiency under these conditions was 60 per cent. and the power factor .49. It was also found that the direction of rotation could be reversed by connecting the tapping from the compensator to the other side of the circuit.

The following is an extract from an interesting reference made by Mr. Eustace Thomas in 1900* on the operation of polyphase motors on single-phase circuits:—"The question has been raised by several speakers as to the possibility of using condensers commercially with single-phase motors. I am able to say that they have, to my knowledge, been used for some time past with success. After what has been said, the Institution may be interested to hear some of the results obtained on the commercial, as distinct from the experimental, scale. A 5-h.p. motor gave a power factor of 90 per cent. and an efficiency of 80 per cent. It further started with full-load torque at $1\frac{1}{3}$ of the full-load current. The motor may be described as a three-phase motor, the single-phase line circuit being joined direct to two terminals of the motor, while the third motor terminal was joined to one side of the single-phase circuit through a condenser. The condenser remains in circuit, and the motor, with its condenser, is treated as though the circuit were three phase. In this case there is no starting coil to be cut out, but the whole of the winding is available both for starting and running. The motor may thus be considerably smaller than the ordinary single-phase machine."

To the writer, the values assigned to the above performances seem rather high, especially so when compared with a three-phase machine of similar output, the efficiency and power factor of which seldom exceed 78 per cent. and .8 respectively.

Perhaps the most satisfactory method of those described is the one shown in fig. 1, where the only apparatus for starting consists of an inductance and a resistance with a suitable double-pole switch for disconnecting them from the mains. By a correct adjustment of the inductance E and the resistance F, sufficiently approximate three-phase conditions will be produced at the motor terminals to enable it to start with something approaching a good specific torque. The writer has had experience of such motors installed in anything but ideal conditions, and their behaviour has always been exceptionally good under some of the most trying conditions that a motor could have.

It is perhaps well known that if a circuit-breaker or fuse operates on one line only of a three-phase system, the motors on that system will continue to run without any appreciable loss of power, provided that a fairly large motor is working on the circuit at the time. This fact constitutes the principle of the method, shown in fig. 5, of running several three-phase motors on a single-phase line. A "pilot motor," which is wound three-phase, and may be started by the method shown in fig. 1, is used to supply the subsidiary motors, the three lines for this purpose being connected to the respective terminals of the motor, which, when running, produces sufficiently approximate phase relations in these lines to enable the dependent motors to start, as though from three-phase mains, with a comparatively satisfactory torque.

It is obvious that such an arrangement may be applied with good effect in factories and the like where the local supply is single phase, and where the demand on the motors renders single-phase working unsuitable.

Referring again to the application of the foregoing methods in respect of railway work, a practical example may here be introduced which was applied a few years ago to the main line of the Norfolk and Western Railway of Virginia. The diagram, fig. 6, shows the connections used in this instance for operating a three-phase traction motor of low voltage on a single-phase, high-voltage line, and the voltages given are the same as those used on the above railway system. Current is supplied from the line to the primary of the single-phase transformer at 11,000 volts, and the windings are so arranged as to produce a secondary voltage of 750. This voltage is applied to one set of stator coils of a single-phase, squirrel-cage motor, which is specially constructed with two stator windings in positions 90 electrical degrees apart. The second winding has one terminal connected to a midway tapping of the transformer secondary, and the other to one phase of the traction motor, the remaining two terminals of whose stator are connected to the extremities of the transformer secondary as shown. Under these conditions the split-phase starting of the single-phase motor is obtained by reason of the two circuits having different power factors, which produce a rotating field. When this motor is running, the rotor currents produced will react on the stator of the traction motor. The voltages set up in both circuits of the single-phase motor by the rotating field and the rotor reactions are in quadrature (the two stator windings being 90 deg. apart), and these voltages, together with those produced by the secondary of the transformer, are adjusted by specially designing the single-phase motor and the traction motor so that the resultant required voltage, applied at the terminals of the latter, shall be of the correct phase sequence. It will be obvious that the production of the transformation of phase is entirely due to the action of the single-phase motor, which is entirely free from mechanical load, and is usually referred to as a "phase converter" when used in conjunction with the above arrangement.

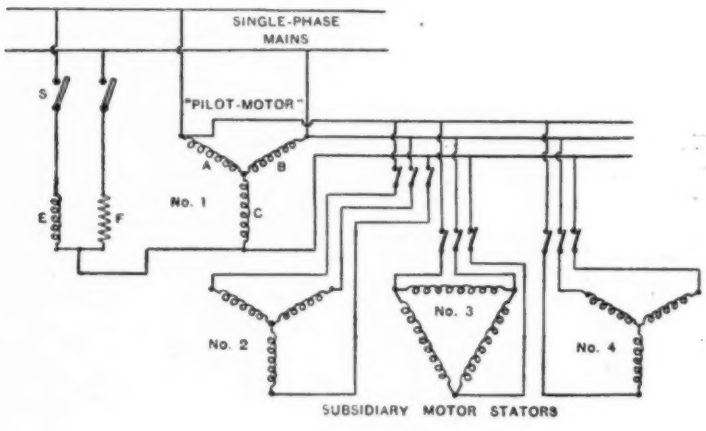

Fig. 5.

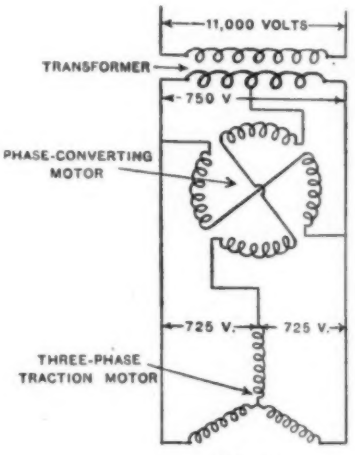

Fig. 6.

* Page 849 of Vol. XXIX (1900), *Journal* I.E.E.

THE POSTMASTER-GENERAL AND ELECTRICAL POWER AND LIGHTING UNDERTAKINGS.

By S. C. BARTHOLOMEW, Construction Section, Engineer-in-Chief's Office, G.P.O. West.

The article by Mr. W. H. Stoker, K.C., in the Electrical Review of September 28th, 1923, with the above general heading, is in effect an attack on the Post Office attitude in the matter of the use of the earth as a return for electric lighting circuits, more particularly, apparently, in connection with the proposed use of a single-conductor lead-covered cable, the uninsulated sheathing of which would be used for the return. It is feared that the attitude of the Post Office on this matter will be misunderstood if the case is allowed to stand on this article, as it clearly implies that not only legally but technically the Post Office attitude is unsound. On both these points I would like to be heard. As a layman, I naturally hesitate to cross swords on legal matters with a barrister, but as Mr. Stoker has ventured with confidence to deal with the technical aspect of the question, I am fortified on my side in pointing out what seem to be inaccuracies on his side.

First of all, Section 26 of the Electric Lighting Act, 1882, was not amended by the Electric Lighting (Clauses) Act, 1899; it was amended by Section 25 of the Electricity (Supply) Act, 1919, in a way not material to the present discussion.

In any case, however, a reference to this Section and to Section 20 of the Clauses Act is not of much moment, as the question of earthing connections is covered definitely by Section 10 of the Clauses Act, 1899, Section (*a*) of which reads: "the energy supplied shall be only by means of some system approved in writing by the Board of Trade and subject to the Board of Trade's regulations"; and (*c*) "the undertakers shall not permit any part of any circuit to be connected to earth except so far as may be necessary for carrying out the provisions of the Board of Trade's regulations, unless the connection is for the time being approved by the Board of Trade with the concurrence of the Postmaster-General and is made in accordance with the conditions, if any, of that approval." It will be seen that the system has to be approved by the Board of Trade—now the Electricity Commissioners—who also formulate regulations which cover matters laid down in Section 6 of the Electric Lighting Act, 1882, which matters include, *inter alia*, "securing the safety of the public." Further, the Commissioners under (*c*) exercise control over earth connections of the system.

In the regulations for "securing the safety of the public," the only obligatory earth connection is the requirement that the intermediate conductor of a three-wire system shall be earthed at one point. Other earth connections are allowed by the Electricity Commissioners either under the approved system or under (*c*), but with certain exceptions, which will be referred to later, these are restricted to "one point only on each distinct circuit." These earthing requirements, drawn up originally by the Board of Trade, have been in force for many years, and by the proviso of "one point only" clearly rule out the use of the earth as a return. The "safety of the public" is a very great responsibility, and I think it may be taken that apart from the effects on the Post Office, railway companies', and other parties' telegraphs and telephones, the Board of Trade's technical advisers had in mind the possible effect on water and gas pipes and other metallic substances in the ground if earth returns were permitted.

I must here quote Mr. Stoker on Section 10 of the Schedule to the Electric Lighting (Clauses) Act, 1899: "the provision is that a connection of a circuit with earth must be approved by the Board of Trade with the concurrence of the Postmaster-General and be made in accordance with the conditions, if any, of that approval. It would appear that the Postmaster-General has recently been seeking to assume sole and original jurisdiction in this matter, and requires the direct submission to him for approval. It is conceived that this assumption of direct authority has no legal foundation, and that it is for the Electricity Commissioners to approve and for the Postmaster-General to concur." I am writing simply as a Post Office engineer having some knowledge of the matter under review, and it may be that things have happened of which I am unaware, but it is certainly news to me that "the Postmaster-General has been seeking to assume sole and original jurisdiction, &c." The Electricity Commissioners are, of course, well able to take care of themselves in matters of this kind, and to satisfy themselves that the Postmaster-General's attitude is a reasonable one technically. In this connection it is suggested that Mr. Stoker has perhaps overlooked the effect of Section 69 (*c*) of the Electric Lighting Act, 1899, under which the Electricity Commissioners may have to forbid the use of an electric line or work if it injuriously affects any telegraphic line of the Postmaster-General. I do not wish to stress the point, but it would certainly be unfortunate if an earthed system approved by the Electricity Commissioners had to be shut down owing to interference with the telegraphs and telephones of the public, and to that extent it is clear that the Commissioners have a responsibility to the Post Office to consider the possible effects of interference when approving systems, or when considering novel earthing proposals.

Under the sub-head of Statutory Notices, Mr. Stoker deals with Section 4 of the Electric Lighting Act, 1888, which is concerned with electric lines or works "not laid down or erected under the provision of a licence, order, or special Act," and I have nothing to say as to this, but I was certainly unaware that "in the case even of electrical undertakers working under the provision of a licence, order or special Act," the Electricity Commissioners can serve a notice applying similar regulations to those served upon the non-statutory undertaker. What are the circumstances in which these regulations would be served upon a statutory undertaker? I cannot recall such a case, and I think it would be a waste of time for statutory undertakers to follow the advice of Mr. Stoker to examine and consider the conditions under which they are working to see whether these particular regulations apply.

I now wish to refer to the technical aspect of the case where my ground is surer. The case for the use of the lead sheathing of a cable for the return current appears to be based on articles in the Electrical Review of May 18th and June 1st last. With every respect I do not think those articles made out a case for the use of such a system in this country. Electrolytic action may perhaps be of little moment as alternating current is proposed, but interference with telephones cannot thus be lightly dismissed! I would like to recite a recent experience which directly bears on the matter. The working of a number of overhead trunk telephone circuits has been interfered with during the last two years, the trouble being traced to a power main carrying single-phase alternating current at extra high pressure, *i.e.*, similar to that suggested in the article of June 1st. The power line is a concentric underground main lead covered and armoured, the outer conductor being earthed at one point only—the generating station. One would expect that with such a main interference with neighbouring overhead telephone lines would be negligible, as the current in the two conductors should be balanced and the electrostatic effects of no account as the main is underground. The curious feature was that the disturbance was confined to the winter months, and

its commencement coincided with lighting-up time. This pointed to out-of-balance due to load, *i.e.*, an electromagnetic effect, and this was confirmed by a test on the inner and outer conductors, which showed a difference of about 25 per cent. between the outgoing and incoming currents. This, of course, again pointed to the presence of a second earth on the system, and for a long time the power company's engineers were baffled as to the position of this second earth connection. It was at one time attributed to a faulty length of cable, but the localising could be got no nearer than a length of about two miles. It was finally found, however, after a great deal of investigation, that the second earth connection only occurred with heavy load, and was in the series coil of a high-pressure meter. The coil of this meter was connected to the outer conductor of the cable, and at periods of light load the coil was not earthed, but when the load grew, the coil expanded with the heat and touched the frame of the meter, causing some of the current to flow to earth through the iron framework of the switchboard at that point instead of returning in balance through the outer of the cable. With the removal of this fault the trouble on the trunk circuits has ceased, and telephone trunk circuits which had temporarily to work *via* other routes have now been restored to their proper lines. If one additional earth can produce this trouble, it is obvious that a conductor earthed throughout its length would produce a greater disturbance. Other cases could be referred to where additional earthing has caused interference.

It is unfortunate that Mr. Stoker should refer to the working of the electrified section of the Brighton Railway, as but for that I might have passed his later statement "that it is well known that telegraph lines are not appreciably affected by alternating currents" on the assumption that he was confining his remarks to the normal working of electric light and power circuits! The principal trouble the Post Office had when single-phase electric traction was introduced on the Brighton Railway was with telegraph circuits, including fire alarm and police circuits, which had to be diverted, as they were rendered unreliable by the normal working of the railway. Telegraph circuits are not usually affected by the normal working of electric light and power circuits, but they certainly are by abnormal happenings on such lines. Mr. Stoker states that the Board of Trade approved a 20-volt drop on the rails of this company. I do not think that this is correct, as no regulations were made by the Board for this single-phase system, although I believe a reference by Sir Philip Dawson in one of his papers might lead one to think that such a drop was approved.

The report of the Joint Committee of the House of Lords and House of Commons, 1893, lends no support to Mr. Stoker's case, as the Committee's report was specially concerned with traction, and his own reference to the exception "other than lighting" bears this out. There appears to be no warrant for the implication that the phrase "uninsulated metallic returns of low resistance" includes the lead sheathing of cables. Uninsulated returns on tramways are subject to rigid regulations as regards voltage drop and leakage to earth, and involve the running of pilot wires and keeping of continuous records of potential differences, *i.e.*, there is an effective control over the uninsulated return, and similar control would be necessary if uninsulated returns were allowed generally for electric lighting currents.

It must not be taken from this, however, that the Post Office has rigidly opposed the use of more than one earth on electric lighting and power systems. Special provision is made in the regulations governing the use of the constant current series system of the Metropolitan Electric Supply Company, that in the event of a fault occurring, an earth return may be used between the two stations on the ring main until it is cleared. Multiple earthing is allowed on the North-Eastern coast on the extensive system of the Newcastle and District Electricity Supply and Associated Companies where interconnection is necessary between the large generating stations, subject to certain conditions. In many districts earthing is allowed on consumers' premises where a low-pressure single-phase system is employed, and the house wiring is of the single conductor type with an external metallic covering. It can be said that all proposals of this character are considered solely in their technical aspect, and if concurrence is refused, it is on reasoned grounds of public interest, and not as suggested in the article "arbitrarily and capriciously"! It may be that some of my readers did not see Mr. Stoker's article, and I would like to quote the following extracts: "It can scarcely be too strongly emphasised that the powers of the Postmaster-General are given to him for the sole purpose of ensuring the protection of his lines from injury, it was never intended or concluded that he would stretch them to the extent of interfering with the economic inauguration and direction of other works by electrical undertakers except in so far as might be necessary for the protection of the Postmaster-General's lines and communications."

The lecturing of the Post Office contained in the above quotations and similar remarks in the article are quite uncalled for, and have been made without inquiry as to the true position.

ELECTRICAL TRADE IN INDIA.

By **BERWHIT** (Calcutta).

Before discussing electrical trade in India, it is perhaps advisable to say something regarding the traders. The majority of electricians in India are natives, in a small way of business; the Parsees are generally salesmen, while the work is done by Mohammedans, Hindus, Eurasians, and Anglo-Indians. The most important member of the trade in India is the wholesale man, who is generally an agent or representative of some large manufacturing concern established abroad. He is the man who controls the industry, and he has before him a market very uncertain in all its stages, for here, of all places, the foreigner is in his element. Germans have again begun to tap this market with great assiduity.

Probably the most important branch of electrical business in India is the supply of fans—a subject which bristles with difficulty. The perfect fan is still awaited, and meanwhile the long-suffering user has to be content with heavy, inefficient, noisy and vibratory fans; for instance, the average fan with three or four blades has a cast-iron carcase (probably ornamental, but useless); ball bearings, sometimes of a doubtful nature; oil feeds in inaccessible positions; windings of a flimsy nature; pieces of paper, rag, and fibre everywhere. When installed, the fan gives too much breeze in one direction, ending in a stiff neck for the user. Repairs are constantly needed, and as the labour for making these is not always of an efficient nature, the consequence is endless trouble.

What is there to prevent makers studying the market and producing a fan which will stand up to conditions? Something of the following sort is suggested: A light alloy case of a material similar to that used in aeroplane work. Standardised armature construction with heat and damp proof windings, on a light core. Accessible bearings of a noiseless pattern fitted with grease cups made solid with the bearing itself. It is necessary also

to arrange for a distributed breeze. The writer has been able to produce in Bombay a fan of this nature at a cost well below that of the average heavy fan now supplied.

Attention must also be directed to the design of regulators. Regulators have been made by several native firms, owing to the unsatisfactory nature of those received from abroad. It is not uncommon when visiting a friend's flat to hear the remark: "Don't alter the regulator, or you'll bust the show," which seems to suggest that there is ample room for improvement.

British manufacturers should therefore endeavour to improve fans and regulators to make them both reliable and easily fitted by native electricians. It may be mentioned, by the way, that the punkah has not made headway in spite of its superior qualities.

Wiring is possibly the next point to be considered. Undoubtedly the cable makers are the live wire of the electrical trade in any country, especially in England, and the number of systems available is too varied to discuss here. Steel conduit of the split-tube type is in use, in spite of its many drawbacks. This system should not be used at all, as it tends to scamped work, no matter what patented fittings are used. One has only to look under floor boards and in dark corners to see what becomes of good cable in split tubing. The screwed system does not allow of cheap work, and except for expensive installations in large European or native buildings, is comparatively little used. Lead-sheathed wiring if carefully erected and under proper fuse control is found to be satisfactory, but the system used principally is that of insulated cable mounted on cleats, and although this lends itself to unauthorised interference, it is still the premier method in the tropics. Cab-tire cable is splendid for loose connections, but for permanent wiring it is more expensive than the ordinary cable, and has very little advantage in general over the latter. For works and buildings that can afford the better class of work, there is no doubt that its use will continue to increase.

About ninety per cent. of the fittings in the East are (or at least were) of foreign manufacture, and even now the trade going abroad is increasing. Some of the finest lighting fittings are produced by English firms, but they are not "pushed" as they should be. The use of reflectors is increasing; the cheap flexible-cord shaded lamp holder is fast dying out. The average interior in the East is seldom dry, yet seldom do we see a switch that is proof against damp, corrosion, and shock. They are all more or less liable to these defects, and if a switch is to be successfully sold, these details must have attention. During twelve years of travel in India, the writer has observed that more than half of the switches in buildings are unsatisfactory. They either leak, or are hard to work, burnt out or nearly so at the contacts, and are far from effective in appearance.

It must not be forgotten that although India is a hot country generally, there are possibilities for the sale of electric radiators. A radiator of good design should have a ready sale in the Punjab.

One of the most popular items in the feminine mind is the electric iron. Here, again, there is room for an improved design.

Toasting, boiling, and other similar appliances are in fairly general use, but the writer cannot safely say that electrical cooking apparatus (of a heavier type) is very popular, owing to the high prices of energy which are the general rule. Most of the hotels, in fact, make an extra charge if the guest uses any electrical apparatus, although plugs are provided in almost every room. In the wealthy residential quarters—and there are many—the possibilities of selling heating apparatus are quite good, and it only needs the attention of salesmen to secure business. Unfortunately, the trade suffers from the lack of energy in getting orders. It appears that British agents are too ready to leave this job to the foreigner and to the ignorant small repairer, who does not know, or care, which is the better apparatus so long as his profit is good.

Other apparatus, such as bells and telephones, again show very little advance in design, and improvement is very necessary. The loud-speaking 'phone would find a ready market.

We next come to theatre and kinema plant. This is a market which should be captured now; theatres are being erected in all parts of India, and there are no firms in the country capable of equipping these on modern lines. The standard equipment now employed is very old-fashioned. Stage lighting and ventilation have made great strides in the West, and there is plenty of room for their application in India. Ventilation especially requires more attention; the head of the largest concern in Calcutta recently pointed out to the writer that he could never get satisfactory ventilating equipment, but had to be content with the usual stock displacement and exhaust fan, unless he was prepared to wait.

Regarding private plant: American plant is so cheap that it is possible to obtain a complete equipment for the price of the generator alone of a British set. Here, again, however, it is purely a question of publicity. The possibilities of the valveless crude oil engine are enormous, if exploited, and we have in England, not only efficient examples of this, but engines in many cases better than those of American manufacture. There are thousands of large native bungalows throughout India at some distance from power supply mains, and many of their owners would be only too pleased to have private installations. The owners want more information and more proof that these automatic push-button plants will give service, with the attention of the unskilled labour which is so plentiful. Crude oil is cheap and available in practically every village in the East (thanks to the Asiatic Petroleum Co.), and this again would provide an impetus to the sale of oil-engine sets.

Many of the State lighting plants are now out of date; most Maharajahs have given this matter close attention, and some are now having either new plant or are modernising their old plant. Once again, education is needed, for even these rulers want enlightening before they will listen to proposals to scrap their old plant. In this connection batteries present an important problem. Whatever batteries the writer has seen in the East show few signs of efficiency; those that are in good condition are generally working under a maintenance scheme, but apart from lack of attention the design itself is often at fault. Little attention is given to the fact that the temperature of the East is very different from that of the West. There are improved types of accumulators on the market, which show considerable advance in storage battery construction, but the writer has not observed much progress in the sale of these. Batteries should be given more space, and more attention during installation, quite apart from questions of design.

It is perhaps natural that more attention should be given to the sale of heavy power plant. This continues to be the best advertised section of the electrical business in India; there are many firms in the field and many energetic salesmen. Nevertheless, there are several little matters which require attention. The native user is by no means careful in his treatment of machinery; he thinks little of placing dirt and tools upon the base of a high-speed generator, and it is wonderful how some motors and generators hold out so long. In a plating shop—one of many—the author has seen the driving motor so covered with dirt that it would be difficult for a serious-minded electrician to believe that it was doing duty. Nevertheless, this only confirms the fact that British plant can give service long after the price is forgotten. It would give more if the climatic conditions were considered when the plant was designed. It is not uncommon to find a quantity of alum and water and other things in readiness for hot bearings, whereas dust-proof bearings would do away with these altogether, as the heat is due, to a great extent, to the presence of dust in the bearings.

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Large plant of 40 b.h.p. and upwards is generally installed where European or thoroughly skilled native supervision is available, and under such conditions the plant gives out its best. There is no bazaar for this class of machinery, the European factors generally ship to order or supply from stock against competition.

No works of importance nowadays, whether in the East or West, is without electric tools, either portable or otherwise, but it is the portable tool which the writer wants to consider. This to be of service must necessarily be expensive; the flimsy, cheap tool is dear at any price, as the scrap heaps of Indian workshops can prove. A heavy tool is not necessary, but it should possess extra strong bearings. The electrical portion should be thoroughly well constructed and capable of withstanding heavy overloads. Drill chucks should preferably be of the permanent grip type, when used in a position where the drill is apt to be dropped, otherwise the automatic grip chuck is suitable. The sales of electric tools are increasing daily, as fast as they are offered. In fact, a tool not yet on the market, but offering unlimited scope, is a small hammer of not more than 4 lb. weight, capable of bushing lead and other lettering on monumental work. Another tool which is required is a flexible shaft attachment for drills, for getting into difficult places. The electrical grinder, if properly designed, will sell anywhere in the motor-car shops, of which there are thousands between Bombay and Lahore. Native dealers and garage owners will be only too pleased to purchase grinders that carry a suitable size of wheel; the useless little tools with a 2-in. wheel cannot be commended for heavy work, but one with a 3-in. or 4-in. wheel gives satisfaction for car cylinders, &c. Heavy duty electric hammer drills have not made much progress so far, on account of the superior qualities supposed to be possessed by a compressed-air tool.

Amongst other plant not dealt with above may be mentioned waterproof-type motors, or motors which will work equally well under water or where it accumulates, as in pumping, &c. A great number of buildings are compelled to pump the water supply to the upper floors, and a reliable pump, costing about £15—preferably of the valveless type—will find a ready sale. The motor generally need not be larger than ¼ h.p., as it generally has to deal only with a town water supply. At present the top flats must pay a small charge to have water pumped to them daily, and the delay and other difficulties would be removed if a small totally-enclosed pump was installed, with a switch near at hand under lock and key.

LEGAL.

United Flexible Metallic Tubing Co., Ltd. v. Visso Corporation, Ltd.

In the Mayor's and City of London Court, on October 4th, a claim was made by the plaintiffs, of 112, Queen Victoria Street, against defendants, gas and electrical engineers, 24, Lower Marsh, Lambeth, to recover £7 10s. for trade goods supplied.—Mr. Cyril Light said he had been manager of the Visso company before its incorporation and he was now managing director of the incorporated company. The goods sued for were supplied before the incorporation of the company and therefore the plaintiffs had sued the wrong people. Plaintiffs' book-keeper said the orders were signed by G. Light and some by a man named Thompson.—Mr. C. Light told the Court that the Visso Corporation, Ltd., was incorporated on June 22nd and he produced the certificate.—Plaintiffs' book-keeper said they thought the Visso Corporation, Ltd., had taken over the debts of the Visso firm before the incorporation. They had no information whether it had or not. —Judge Shewell Cooper said the orders were given on behalf of the Visso company before the incorporation, when the proprietors were Mr. G. Light and Mr. Cyril Light.—Mr. C. Light informed the Court he was to have become a partner but he had to accept a salary.—Judge Shewell Cooper said that technically speaking, the plaintiffs had brought the wrong parties before the Court, as the Visso Corporation, Ltd., was registered after the orders were given and the proper defendants were the firm before the incorporation.—Mr. C. Light said Mr. G. Light was prepared to pay the account.—Plaintiffs' book-keeper said Mr. Light had promised to send them a cheque many times and it had never come.—Judge Shewell Cooper said he would amend the proceedings and make the Visso company the defendants and he would give judgment for the plaintiffs for the amount claimed, with costs against the Visso company only, and not the limited company.

Two Meter Cases at Blackpool.

At Blackpool, on October 5th, George William Hodge, North Albert Street, was fined £5 for abstracting electricity from a meter and using it for lighting purposes.

Defendant has a workshop with two meters. On June 23rd he instructed the Corporation to remove the lighting meter, and the only one left was for power. About June he went to reside over the workshop, and the suspicions of the authorities were aroused owing to the high power consumption. Investigation revealed the fact that five lamps had been connected to the power circuit, thereby consuming a considerable amount of electricity at power rate.

Blackpool magistrates the same day fined Samuel Hart, of Ripon Road, 20s. for connecting an electric meter without notice. An employé of the Corporation Department called at defendant's house and found the seal broken and the fuse replaced, thereby providing a supply for the house without authority. Defendant denied the offence.

Electric Arc Welding Prosecution.

Interesting points were raised in a prosecution at Chesterfield on October 6th, which was a sequel to a fatality which occurred in August at Pleasley Mills, near Mansfield. Messrs. Hollins & Co., Ltd., worsted spinners, Pleasley Mills, were summoned by the Inspector of Factories for failing to take precautions to use apparatus in connection with the repair of a boiler by means of an electric arc welding process so constructed as to prevent danger in its use, and in consequence of which Charles Keeling was killed. The South Yorkshire Electric Welding Co., Ltd., Mansfield, was similarly summoned as agent of Messrs. Hollins, while the Welding Co. was summoned by Messrs. Hollins for failing, while employed by the factory owners, to use properly constructed apparatus, and to take proper precautions. Mr. John Law, Superintending Inspector of Factories, Sheffield, stated that Keeling and Robert Marsh were engaged as employés of the Welding Co., in repairing a boiler. Keeling was inside the boiler using arc welding apparatus, which included a kind of pliers, which he (Mr. Law) contended were not properly insulated. Keeling was found dead in the boiler. Gloves were found in the boiler, and the presumption was that they were not being worn at the time of the accident. He also submitted that the voltage was higher than was found in general practice. Among the witnesses was Robert Marsh, who said that while in the boiler Keeling placed his head under a feed pipe. The Welding Co. provided all the apparatus, cable, gloves, &c. The cable was connected up to Messrs. Hollins's switchboard. He had not seen Keeling working without gloves. It would be easy for them to fall off when he received the shock. Mr. H. W. Swann, Electrical Inspector of Factories, said he was informed that the supply of current was taken from a 220-V generator. For electric welding 45 to 50 V was the minimum and 100 V the maximum. Anyone using over 100 V would not be taking proper precautions for safety, and any pressure over 100 V would be exceptional and quite unnecessary. If Keeling had received the shock in a less vital part than the mouth he did not think it would have been fatal. Mr. Roome, in Messrs. Hollins' defence, held that his clients were not liable for the fault of an independent contractor who happened to be at work at the mills. It would not have been suggested that Messrs. Hollins were liable if the boiler had been sent to the Welding Co.'s premises. For the Welding Co.'s defence it was urged that all necessary precautions were taken. The cases occupied a considerable time, and in the end all were dismissed.

King v. Gill.

At Marylebone County Court, on October 4th, before the Registrar (Mr. Vaughan-Roderick), Stanley Herbert King, an electrician, Notting Hill, sued Mrs. Gill, a hairdresser, Notting Hill Gate for £2 14s., on account of electrical work executed.

The Registrar gave judgment for the plaintiff for the amount claimed, with costs.

Bogus Electrician Charged.

At Westminster Police Court, on October 8th, George Arthur Wells was charged with robberies at flats and houses in London, having gained entry by representing himself to be an electrician inspecting the lighting. Three specific cases were put forward by the police, and it was mentioned that in all probability additional charges would be preferred against the prisoner. The magistrate remanded the accused in custody.

BUSINESS NOTES.

Bankruptcy Proceedings.—Horace Coleman, 66, Victoria Street, Westminster, London.—The first meeting of creditors was held on Tuesday at the London Bankruptcy Court, under the failure of this debtor, who is acting as manager and traveller for Coleman and Warren, wholesale electrical engineers, carrying on business at the above address. A statement of affairs was submitted showing liabilities of £1,212 and assets "nil." Mr. Walter Boyle, senior Official Receiver, reported that it appeared from the debtor's statements that he was employed by various electrical companies until the early part of 1913, when, with two others, he commenced business as electrical engineers at Queen Anne's Chambers, Westminster, under the style of Ardcole and Turner. In the following June the partnership was registered as Ardcole and Turner, Ltd., and the debtor acted as a director thereof until he joined the army in November, 1914. He was demobilised in June, 1919, with a gratuity of £110 and a small pension, and then resumed his directorship of Ardcole and Turner, Ltd., until he resigned the post in March last. Since then he had been employed in the business of Coleman and Warren. That business was financed by Mr. Warren, and the debtor's name was utilised as there was a goodwill attaching to it in the electrical engineering world. It further appeared that in October, 1922, the debtor and a Mr. McClelland rented premises at North End, Croydon, and there started business as the Surrey Wholesale Electrical Co. Under the partnership arrangement the profits and losses were to be equally divided. Mr. McClelland financed the launching of the business, and the debtor acted as buyer and traveller. He resigned from the partnership in June last, and the Surrey Wholesale Electrical Co., Ltd., was registered to take over the business. The debtor had no interest in the company. He attributed his failure to a period of unemployment and to his having lived beyond his means. The case was left in the hands of the Official Receiver to be wound up in bankruptcy.

The British Radiophone Company, Downing Street, Bulwell, Nottingham, makers of wireless apparatus. The adjourned public examination of Norman Williams, Mabel Williams, and Walter Cook, trading as above, was held on October 4th, at the County Court House, Nottingham. Debtor N. Williams admitted having received a cheque for £200 in respect of an order which he did not complete, and further stated that he could not fulfil other subsequent orders. He admitted that unless they had the money in advance they could not get the material to meet the orders. Mabel Williams admitted having previously been a partner in her husband's business until a receiving order was made against him, but she declared that she had no separate assets or liabilities. She had had no active control in the business. On behalf of Cook an application was made to dispense with his public examination on account of ill-health. The examination was closed.

E. E. Mearns, electrical contractor, 14, St. Bede's Road, East Boldon.—Last day for proofs for dividend, October 24th. Trustee, Mr. C. Woollett, Official Receiver, Pearl Buildings, 4, Northumberland Street, Newcastle-upon-Tyne.

W. H. Vevers (W. H. Vevers & Son), builder, &c., and electrical engineer, 91, King Street, Maidenhead.—Last day for proofs for dividend, October 20th. Trustee, Mr. W. Boniface, 10, Serjeants' Inn, E.C.

Cyril Walter Stocken and Conway Fink, trading as the Wyndham Radio Supplies, 80, Redcliffe Street, Bristol.—The adjourned first meeting of the creditors was held recently at the Official Receiver's offices, 26, Baldwin Street, Bristol. The gross liabilities were returned at £754, and there was a deficiency of £407. At the previous meeting it had been stated that there was hope that debtor would offer a composition, but this had fallen through. The creditors therefore appointed Mr. J. P. Emmett as trustee, and a committee of inspection was also nominated.

H. J. A. Maullin (Wilton Engineering Co.), electrical engineer, 124, Devonshire Street, Birmingham.—Discharge suspended for two years as from September 13th, 1923.

P. M. Rogers (Longbridge Engineering Co.), electrical engineer, Great Darkgate Street, Aberystwyth.—Last day for proofs for dividend, October 20th. Trustee, Mr. H. W. Thomas, 4, Queen Street, Carmarthen.

E. W. J. Whitelock, electrical engineer, 4, Leagrave Road, Luton.—Receiving order made October 2nd on debtor's own petition.

Private Arrangements. — Morgan & Taylor's Radio Electric, Ltd., 122, Wellington Street, Cardiff.—The creditors interested herein were called together recently at the offices of Messrs. Clarke, Dovey & Co., accountants and auditors, 31, Queen Street, Cardiff, when a statement of affairs was presented which showed liabilities of £4,046, made up as follows: Unsecured creditors, £2,979; bankers, £967; and cash creditor, £100. The assets were estimated to realise £2,750, and consisted of: Stock-in-trade, £1,000; utensils and fittings, £150; and book-debts valued at £1,600. A balance-sheet was also submitted, which showed the position of the company as at July 31st last, and this disclosed liabilities of £4,851, consisting of share capital, £703; sundry creditors, £3,081; bankers, £967; and cash creditor, £100. At that date the assets comprised stock-in-trade at cost, £1,542; plant, machinery, tools, &c., £338; sundry debtors, £1,946; cash in hand, £5 17s. 3d.; British Broadcasting Company shares, £10; insurances unexpired, £6; telephone and telegraph unexpired, £5; preliminary expenses, £192; and radio agreement, £11. It was reported that the meeting had been called in consequence of two trade creditors commencing proceedings. The directors felt that it was only fair to put the company's position before the creditors to see if some arrangement could be entered into. The company was registered in July, 1922, with a nominal capital of £1,000, in £1 shares. The issued capital was £703, of which £403 had been issued for cash. Between July 13th, 1922, and July 31st last, when a balance sheet and profit and loss account was prepared, there was a turnover of approximately £8,000, and after allowing for all the expenses there was a net loss of £817. The loss was due to the fact that the wages, salaries and travelling expenses had been very heavy. A question was asked as to whether any offer would be submitted, and it was stated that Mr. E. Horley, one of the directors, desired to help the company, but it was not thought that if the assets were forcibly realised they would produce the sum at which they were set down in the statement of affairs. Consequently the offer which had to be submitted was to purchase the claims of the creditors against the company for 5s. in the £, payable in cash. The matter was discussed at some length and eventually it was decided that the offer submitted was inadequate, but that seven days should be given within which to allow of an offer of not less than 10s. in the £ being submitted, payable and secured to the satisfaction of the five principal creditors. The opinion was also expressed that failing such an offer being forthcoming the company should go into voluntary liquidation and appoint Mr. S. E. Clutterbuck (of Messrs. Clarke, Dovey & Co.), as liquidator. The following are creditors:—

	£		£
Auckland & Son, G. Z.	250	Metropolitan-Vickers Electrical Co.	58
British Thomson-Houston Co., Ltd.	80	McMichael, Ltd.	200
Concordia Electric Wire Co. Ltd	69	Morgan, T. W.	16
Clarke & Co., Ltd.	64	Mas Advert Co., Ltd.	20
Edison & Swan Electric Co. ...	184	Rose Bros. Electric Co., Ltd. ...	11
Engineering Equipment Co. (1919), Ltd.	87	Siemens Bros. & Co., Ltd. ...	165
General Electric Co., Ltd. ...	30	Sterling Telephone & Electric Co., Ltd.	87
India Rubber, Gutta Percha and Telegraph Works Co., Ltd. ...	376	Siemens & English Electric Lamp Co.	58
Igranic Electric, Ltd.	60	Western Electric Co., Ltd. ...	845
		Taylor, G. P.	100
		Horley & Son, Ed.	130

A. G. Purdy and J. M. Clark (Purdy & Clark), electrical, wireless and general engineers, 295, Goswell Road, London, E.C.1.—A meeting of the creditors was held at the above address on October 5th, when Mr. E. Judd, of Corfields Traders' Association, 181, Queen Victoria Street, E.C., representing the largest trade creditors, was elected to the chair. No statement of affairs was presented, but the debtors estimated that the liabilities were a little over £300, while the assets were stated at approximately £60. It would appear that the debtors commenced business about four and a half years ago with a capital of £50 each. Their drawings were at one time £4 weekly each, but Mr. Clark stated that during the last eighteen months they had only drawn from £2 to £3 10s. weekly each. The rent of the premises was £56 a year, while the rates were about £8 per quarter.

In reply to Mr. Judd, Mr. Clark said that no books had ever been kept, and he could not say what the turnover had been or whether any gross profit had been made. Mr. Clark added that the bailiffs had been in possession, and had taken approximately £43 worth of stock, &c., away.

It was stated that creditors had been pressing for about 18 months, and Mr. Clark said that they had paid out £97 2s. 3d. for costs during the last year or two. The chairman thought that the debtors should have called their creditors together before and placed the position before them.

The matter was discussed at some length, and eventually the meeting broke up without any resolutions being passed. The debtors stated that they would not be able to raise any money to file their petition in bankruptcy, and they had no offer to make.

Company Liquidations.—Yorkshire and District Electric Lamp Repairing Co., Ltd.—A meeting of creditors was held at Sheffield on October 4th. The liquidator, Mr. Horace Cawood, said he was appointed liquidator by the shareholders on September 18th. The reason of the failure of the company was the action taken by one of the big companies for an injunction claiming that the business of the company was an infringement of its patent. This was fought by the directors and a victory gained in the interim injunction, but in the general action in the High Court a verdict was given against the company. The debenture holders immediately appointed a receiver, but the assets, all of which, except the property which had been or was being taken possession of by the mortgagees,

had been realised, and were not expected to amount to much, if any, more than would be sufficient to meet the costs and preferential creditors. The directors had, he understood, personally found a considerable sum for the purpose of fighting the action in the High Court, and were very heavy losers. The property was offered by auction but was not sold.

Electric Blasting Apparatus Co., Ltd.—Winding up voluntarily. Liquidator, Mr. P. J. Cory, Nobel House, Buckingham Gate, S.W.1. Meeting of creditors at Nobel House, October 17th.

Birmingham Radio & Engineering Co., Ltd.—Particulars of claims to the liquidator, Mr. J. A. Garland, 148, Edmund Street, Birmingham, by November 12th.

Newington Electrical Co., Ltd.—Mr. P. S. Booth, of 2, Bixteth Street, Liverpool, has been appointed a liquidator of the company, with Mr. D. Bell, of 14, Dale Street, Liverpool, and a committee of inspection.

Yera Electrical Co., Ltd.—Winding up voluntarily. Liquidator, Capt. M. Evans, 2, Melbourne Place, Strand, W.C.

"Z" Electric Lamp Manufacturing Co., Ltd.—Particulars of claims to the liquidator, Mr. B. H. Binder, 80, Bishopsgate Street, E.C., by October 26th.

Trade Announcements.—Messrs. Switchgear & Cowans, Ltd., Old Trafford, Manchester, announce that their telephone number has been altered to "Trafford Park 1107 and 1108."

Messrs. McKeand & Foulger have removed to larger premises at Albion Yard, Penny Street, Blackburn.

Messrs. Lord, Pickard & Co., of 7, Bedford Circus, Exeter, have been appointed West of England agents for Messrs. Robinson and Hands Electrical Co., Ltd., of Birmingham, Messrs. Morgan's (Birmingham), Electric Motors, Ltd., of Birmingham, and other engineering companies.

Mr. Harry Moss, of 82, Leeds Road, Bradford, has just taken over the connection and goodwill of the business which has been carried on by Mr. George Newby at Tyrrel Street, Bradford, for the last 32 years. Mr. J. W. Drury, who has been manager of Mr. Newby's business for several years, has joined Mr. Moss's staff.

Mr. J. Gledson has taken into partnership his son, Mr. W. R. Gledson, and Mr. G. S. Killey, who has been with him for 14 years. The style of the firm (J. Gledson & Co.) will be unaltered. Additional premises have been taken at 26, Eldon Square, Newcastle-upon-Tyne, adjoining the firm's present building at 48, Blackett Street.

Mr. Alex. Brewster, for 18 years with Messrs. Lockheart and Macnab, has commenced business as an electrical engineer at 6, Baker Street, Stirling.

Messrs. Heyes & Co. have opened a showroom at 65, Mesnes Street, Wigan, for the sale of radiators, cookers, vacuum cleaners, wireless accessories, &c.

Electrical Utilities, Ltd., informs us that it has moved into new and up-to-date works, and its address is now Tudor Works, Park Royal, N.W.10. Telegrams: "Utilelec, Harles, London"; telephone, "Willesden 3180." Several new devices are on the way, and facilities are now available for production on a larger scale.

Messrs. J. & J. Kimber have opened premises at 81, Whitehorse Road, Croydon, for the wholesale supply of electrical accessories and fittings, and have appointed Mr. Thos. Hyde as manager.

Mr. Charles White has removed to 26, Upper Thames Street, London, E.C.4. In addition to lighting and bell supplies he will now carry stocks of electric light fittings, fuseboards, &c. New 'phone No.: "City 1842."

Catalogues and Lists.—Mr. T. D. D. Geesin, 4, Clevedon Road, Penge, S.E.20.—An illustrated card giving particulars and prices of an electrical testing set and a tachometer.

The Runbaken Magneto Co., Ltd., Derby Street, Manchester.—A descriptive pamphlet dealing with an armature winding machine. Illustrated and priced.

Messrs. Siemens Bros. & Co., Ltd., Woolwich, S.E.18.—Catalogue 150, a profusely-illustrated list of paper-insulated cables and joint and terminal boxes. Views of the firm's factory are given. Also Catalogue 595, containing illustrated particulars of radio-telephony accessories—'phones, loud speakers, batteries, &c. Priced.

Messrs. Jenson & Nicholson, Ltd., Goswell Works, Stratford, E.15.—Two booklets treating respectively of insulating varnishes and enamels, and industrial varnishes, japans, &c.

Mr. George Ellison, Perry Barr, Birmingham.—List No. 66, describing totally-enclosed, non-automatic, air-cooled rotor starters; and List No. 71, illustrating air-break, air-cooled stator and rotor control panels.

Messrs. Henry Joseph & Co., Ltd., 96, Victoria Street, S.W.1.—An illustrated booklet dealing with cabinets and cases for instruments, accumulators, radio sets, &c.

Messrs. Archibald Low & Sons, Ltd., Merkland Works, Partick, Glasgow.—Catalogue No. 923, containing prices and illustrations of "Highlow" heating apparatus of the electric-steam and electric-water types.

Messrs. Edward G. Herbert, Ltd., Atlas Works, Chapel Street, Levenshulme, Manchester.—An illustrated catalogue of metal-sawing equipment—hack-saws, a saw-sharpening machine, and a sawing machine.

Messrs. F. Thomas & Co., 189, Drummond Street, N.W.1.—Additional catalogue sheets illustrating standards and shades for lighting purposes. With separate price list.

Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, S.W.1.—October stock list of motors and dynamos.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham.—Sheet No. 27,923, a price list of flexible metallic tubing and fittings.

Sterling Telephone & Electric Co., Ltd., 210-212, Tottenham Court Road, W.1.—A trade catalogue of radio components and accessories. Fully illustrated and priced.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—A priced and illustrated catalogue of "Sunco," "Belling," "Cosmos," "Heatrae," "Flamingo," "Jackson," "Premier," and "Polar Cub" fires. Also a leaflet describing the "Apex" re-wireable fused switch. Illustrated and priced.

Brookhirst Switchgear, Ltd., Northgate Works, Chester.—An illustrated and priced catalogue (No. 5) describing in detail the construction and operation of "Safety First" iron-clad control gear for d.c. motors.

The London Factors & Agents, Ltd., 38 & 39, Parliament Street, S.W.1.—Net price list of electrical accessories of all kinds for October.

Credenda Conduits Co., Ltd., Whitehouse Street, Aston, Birmingham.—An illustrated and priced pamphlet dealing with the "Nonpareil" series of electrical appliances—kettles, irons, and bowl fires.

Siemens & English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4.—October price list of electrical supplies, illustrating lamps, lighting fittings, fires, switches, radio apparatus, &c.

Book Notices.—"Faraday House Journal." Vol. X; No. 4. Michaelmas, 1923.—This issue, in addition to the usual notes and notices of interest to Faradians, contains some "Notes on the Alexanderson System of C.W. Telegraphy," by T. R. Beckett; an interesting article on "Electrical Phenomena at High Altitudes," by F. S. Smythe; and a description of "A Simple Method of Finding Faults on Cables," by R. W. C. Reeves, which, if apparently somewhat crude, has been used with success on a d.c. 3-wire, 400-volt network at Hereford.

"The *Transactions* of the South African Institute of Electrical Engineers." Vol. XIV. Part 8. August. Johannesburg: The Institute. Price 2s.—The principal paper reproduced in this issue is a description of the Central sub-station of the Johannesburg electricity supply system by B. Sankey and A. T. Rodwell. Other papers which appear are: "Automatic Telephony," by V. Amberg, B.Sc., and "Radio-Frequency Amplification," by A. Chenik.

"The *Journal* of the Junior Institution of Engineers." Vol. XXXIV. Part 1. October. London: Percival Marshall and Co. Price 2s.—This first number of a new volume contains the annual report upon the 1922-23 session. Several papers are reproduced, including "The Use and Abuse of Reflectors in Lighting," by N. Thornton, and "The Carbonisation of Coal," by H. B. Holliday, B.Sc. The journal also contains notes of visits, reviews, &c.

"The Electrical Contractors' Year Book, 1923-24" (362 pp). London: The Electrical Contractors' Association, Inc. Price 2s. 6d. The new edition of this work varies little in form from its predecessors. The membership lists have been brought up to date; Mr. Marryat's presidential report is reproduced; and a portrait of the president for 1923-24 (Mr. R. Robson) appears as a frontispiece. Another new feature is a section on the E.C.A. trading policy.

"Radio and High-frequency Currents," by E. T. Larner. Pp. viii+56; figs. 22. London: Crosby Lockwood & Son. Price 3s. 6d. net.

"Radio Telegraphy and Telephony," by E. W. Marchant. Pp. ix+137; figs. 30. London: Hodder & Stoughton. Price 6s. net.

"Successful Wireless Reception," by P. D. Tyers. Pp. vii+88, 48 illustrations. Price 1s. 6d. net; "Wireless Facts and Figures," by A. V. Ballhatchet. Pp. 52, 15 illustrations. London: Percival Marshall & Co. Price 6d. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LXI, No. 322. September, 1923. London: E. & F. N. Spon, Ltd. Price 10s. 6d. The September issue contains the following papers:—"X-ray Examinations of Materials," by Mr. A. G. Warren; "Electric Line Calculations: Their Practical Application to Transmission and Distribution Problems," by Mr. W. T. J. Atkins; and "Wireless Direction-finding in Steel Ships," by Mr. C. E. Horton. Also reports upon "H.d. Copper Wires and Cables," "H.d. Aluminium Wires and Cables," "Galvanised Steel Wires and Cables," and "Steel-cored Aluminium Cables for Overhead Transmission."

Waring & Gillow's Exhibition.—The General Electric Co., Ltd., has arranged a comprehensive exhibition of electrical appliances, lighting fittings, &c., at the Oxford Street showrooms of Messrs. Waring & Gillow. The display embodies examples of most of the "Magnet" appliances: fires, irons, kettles, &c., "Gecophone" radio sets, floor and table standards, washing machines, and a small lighting set. One window is also devoted to the display of electrical apparatus, including a "Thor" washer in motion. The exhibition is additional to the firm's permanent electrical showroom, in which artistic lighting fittings predominate.

South African Trade.—*Reuter's Trade Service* correspondent at Cape Town, writing about the middle of September, says: "Engineering shops report somewhat more briskness just now. Prices for raw materials are becoming firm, especially in the case of timber. There is every indication that there is going to be a busy time in the future, from both the commercial and industrial point of view, as soon as a settlement has been reached in Europe. Independent of everything else, there are large undertakings about to be started, including a scheme to increase the capacity of the Steenbras reservoir from 5,000,000 gallons a day to 20,000,000; the electrification of the suburban railway, a total length of about 30 miles; the erection of the great wireless station at Klipheuvel; the erection of the University of South Africa at Groote Schuur; and a number of other large contracts. On the whole the outlook is brighter."

A.B.T.-H. Lighting Campaign.—The winter lighting publicity efforts of The British Thomson-Houston Co., Ltd., present "Mazda" lamps and lighting service to the public in a number of forms. In addition to the usual lamp pamphlets—the cover of one being reproduced herewith—the firm is issuing illustrated descriptions of its "Eye-Restolite" system, white "Mazda" lamps, &c. Full advantage is being taken of the daily Press. Full front-page advertisements are being displayed which, in addition to their main object, are educative. Many questions relating to light, and their answers, appear in these advertisements, and they are undoubtedly of an attention-compelling nature.

"The Sun's Only Rival."

Russian Notes.—*Work in Turkestan.*—An engineering committee representing the Central Electrical Trust of Moscow has visited Tashkent to become acquainted with the preliminary work in connection with the establishment of a hydro-electric station in the region, which is to be carried out by the Trust under a contract concluded with the Tashkent authorities. The station is to be of 4,500 h.p., and is to be set in operation next summer.

Manufacturing by the Trusts.—The value of the production of the Central Electrical Trust in August is reported to have amounted to 1,307,000 gold roubles. The installation work alone increased by 265 per cent. over that of the previous month. In the case of the Electrical Machine Trust, which employed over 5,000 workers in August, the output of manufactures rose by 26 per cent. over the July figure and amounted to 1,122,000 gold roubles. Similarly the turnover of the Weak Current Trust was greater by 30 per cent. than in July.

Constructional Work.—The Electric Exploitation Co., which was formed with an original capital of 150,000 gold roubles, is shortly to convene a meeting to increase the amount to 1,000,000 gold roubles. Various contracts have been concluded by the company with several executive committees in the province of Moscow for the equipment of hydro-electric stations, and work has already been begun on two of these stations on the rivers Moskve and Pakre. The company is making a practice of assisting local committees and co-operative organisations in the establishment and working of generating stations.

The Import of Lamps.—It appears from a recent discussion before the State Planning Commission that gasfilled lamps and 220-V lamps are not manufactured in Russia. This fact was revealed on a proposal being put before the Commission that sanction should be given to the importation of 2,500,000 incandescent lamps in the new financial year which began with the persent month, this number including lamps of the two types in question. The commission decided that it had not been proved to be necessary for the number of lamps in general to be imported, but left open the matter of the half-watt and 220-V lamps until the presentation of a further report by the industrial section and the Electric Planning Committee.

The Petrograd Electric Power Works.—It is stated that the Electric Power Works of Petrograd, which formerly obtained all its plans and patterns from abroad and then copied them, now has a staff of forty engineers engaged on the preparation of drawings out of a total number of 700 persons employed. Among the manufactures produced in the past twelve months are mentioned four generators of 10,000 kW for the Volkhov generating station and other works. Plenty of orders are on hand, but difficulty is experienced in executing them in consequence of the scarcity of raw materials, especially dynamo sheets.

Lead.—Reporting under date October 6th, Messrs. James Forster & Co. state: "Leading operators were in evidence, purchasing considerable quantities of metal for all positions. Prompt lead is scarce and £27 5s. (or 15s. per ton above the October shipment price) has been paid this week by consumers. It is difficult to believe that all the lead recently arrived has gone into consumption, but so it is asserted. Consumption in sheets and pipe creeps up but is not materially more than last year. The electrical trade is busy and is consuming more lead than for some months past, the Government having placed considerable orders for telephone work. Arrivals this month are likely to be considerably short of the August and September imports, with a marked scarcity of special brands."

The Foreign Article.—In the course of a letter on unemployment to the editor of a Glasgow evening paper, the manager of a British firm manufacturing a standard article used by power users, says the curse of our country is that the creed of so many is that unless an article comes from a foreign country it cannot be right, and that he has had repeatedly to reprove buyers for their lack of discrimination in this respect. He continues: "No doubt there are some good things made in foreign countries, but surely from a business, if not from a patriotic, point of view, when the British article is as good, if not superior, to the foreign article, it should get all the preference every time; all the more so when the British article is cheaper than the foreign one. The truth of the matter is, that so-called buyers, who are mostly clerks having no practical experience, are placed in positions they are not fitted for, and do not know what the article they are out to buy should be. Some of our leading power users are adopting the plan of placing only practical men in these positions. Another point. There are far too many agents who look upon an article only by its selling value and who don't care where it comes from. They are on a par with a buyer whom the writer met lately, who declared he didn't care if the article came from hell, he would buy it provided it was cheap enough."

Siemens Sports Club.—On October 3rd a concert was given by the Siemens Sports Club in the Town Hall, Woolwich, and this was followed by the distribution of prizes. The musical items were of a high order and beautifully rendeerd by the artists, who included Miss Gladys Glyn, Miss Connie Marshall, Messrs. Bert Cleveley, Bert Hughes, Harold Knowlton, Harry Roberts, and Issaye Schlaen. The prizes were distributed by Gen. Sir Hubert De La Poer Gough, G.C.M.G., one of the directors of Messrs. Siemens Brothers & Co., Ltd.

Pound Loans in Germany.—The latest scheme brought forward in Germany is the creation of a pound sterling loan by the Wurtemberg Electricity Co. of Stuttgart. It is composed of a 7 per cent. debenture loan of £120,000, divided into denominations of £2 10s., £5, £10 and £25; is stated to have been taken over from a German banking group, and having as trustees the London firm of J. Henry Schroeder and Co. It appears that the Wurtemberg company has a long lease of the Wiestal power station and the Salzburg generating station, and has undertaken to complete a third station now in course of construction, the loan in question being required to carry out developments in connection with these undertakings.

British Empire Exhibition Note.—It is reported that the Eastbourne Electricity Committee has decided to contribute £50 towards the expenses of the E.D.A.'s electrical exhibit.

Copper and Lead Prices.—Messrs. F. Smith & Co. report October 9th:—Copper (electrolytic) bars, £65, 45s. decrease; do., do., sheets, no change; do., do., wire rods, £75, 45s. decrease; do., do., h.c. wire, 9 7/16d., ¼d. decrease. Messrs. James & Shakespeare report October 10th:—Copper bars (best selected), sheet and rod, no change; English pig lead, no change.

Tata Power Developments.—Following upon the announcement issued at the beginning of the present year, that under the Trade Facilities Act an amount of £850,000 was to be guaranteed in respect of the Tata hydro-electric power scheme, we see in the "City Comments" of *The Times* for October 8th that the Trade Facilities Advisory Committee has decided to guarantee £1,000,000 of debentures of the Tata Power Co., the most important of the Tata group of electrical undertakings in India. Arrangements have also been made to place privately with a group of trust companies £750,000 of second mortgage debentures carrying interest at 7½ per cent. The writer states that orders are being placed with English manufacturers to the value of over £1,000,000. Contracts have been entered into between the Tata Co. and the Great Indian Peninsula Railway, the Bombay, Baroda, and Central India Railway, the Bombay Power & Tramways Co., and the Bombay Cotton Mills for the supply of electrical energy exceeding 210,000,000 kWh per annum. It is expected that the company will be in a position to deliver this amount of energy by 1925. The total cost of the work is estimated at nearly £4,000,000.

British Trade-mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month from the dates mentioned.

Electromatic. No. 436,069. Class 8. Electric time signalling apparatus. Gent & Co., Ltd., Faraday Works, St. Saviour's Road East, Leicester. October 3rd, 1923.

Dribat. No. 431,970. Class 8. Apparatus for use in wireless telephony and telegraphy. Western Electric Co., Ltd., Connaught House, Aldwych, London, W.C. October 3rd, 1923.

Phonnite. No. 438,126. Class 8. Crystal detectors for use in wireless telephony and telegraphy. Henry L. Sulman and Hugh F. K. Picard, 44, London Wall, London, E.C. October 3rd, 1923.

E.D.A. Salesmanship Conferences.—In the programme already issued for the London Area, the meeting for Friday, April 11th next, was left blank. The arrangement has now been made; Mr. W. Y. A. Anderson (Birmingham Electricity Supply Dept.) will read a paper on "Selling Electric Power." Mr. B. Longbottom, M.I.E.E., M.I.M.E. (Messrs. Electromotors, Ltd.), will preside.

For Sale.—The Controller, P.O. Stores Department, invites offers for 19 electric motors, 18 dynamotors, 20 motor generators, switches, panels, &c. Under deed of assignment, Messrs. Griffin & Hand, the trustees of the estate of J. H. Berry, trading as Bill & Berry, wholesale electrical suppliers, 18-26, Constitution Hill, Birmingham, invite offers for the stock, fixtures and fittings, and books debts of the above business. (See our advertisement pages to-day.)

Local Exhibition.—Glasgow.—Electrical appliances occupied a prominent position in the recent Health and Housing Exhibition at the Kelvin Hall. The Corporation Electricity Department had a very comprehensive exhibit which included cookers and fires of the type supplied under the special hiring scheme. Among the other exhibitors were Messrs. Kemp, Williams & Colquhoun, Ltd. (electric signs); James Meighan and Son (lighting, heating, and cooking apparatus); Kirby, Johnston & Co. ("Jackson" cookers and "Venner" time switches); the Falkirk Iron Co., Ltd.; Hotpoint Electric Appliance Co., Ltd.; Archibald Low & Sons, Ltd.; Igranic Electric, Ltd.; and many other well-known firms.

Rand Electricity Supply.—The *Financial Times* reported this week that the Witwatersrand mining companies had obtained an interim interdict restraining the Electricity Board from proceeding with the inquiry regarding the Victoria Falls and Transvaal Power Co.'s proposed station at Witbank, on the ground that the essential particulars stipulated in the Electricity Act had not been supplied by the Power Co., preventing the mines from presenting a proper reply. In the negotiations between the Power Co. and the mining companies, the difference in the prices put forward by the two parties was £500,000 per annum, and as the contracts are made for 20-year periods many millions were involved in the dispute. The secretary of the Victoria Falls Power Co. has written to our contemporary stating the interdict has been discharged. Moreover, he points out, the suggestion that the supply of a large quantity of power from the Witbank station would enormously enhance the company's profits must be accepted with reservation, as the contracts are affected by declines in the price of coal. The company has promised to furnish the required particulars.

Trade Inquiries from Penang.—The Electric Supply and Tramways Department of the Municipality of George Town, Penang, invites information and catalogues in connection with the following:—Asbestos paint suitable for bare wire resistance elements; still for distilling water electrically; steel and phosphor bronze binding wires. Address: Engineer-in-Chief and Manager of the Department, as above.

Battery Price Reductions.—Messrs. C. A. Vandervell and Co., Ltd., announce a further reduction in the price of accumulator batteries for Ford cars.

Catalogues Required.—Messrs. Harmer-Holman, consulting engineers, 50, Castle Road, Southsea, Portsmouth, wish to receive catalogues, &c., of electrical equipment of all types.

Francs in the Saar.—The Electrical Apparatus Construction Co., of Freilautern-Saarlouis, has convened a general meeting to consider a final balance sheet in marks and an initial balance sheet in francs. It is also intended to convert the mark capital into francs, which will then amount to a maximum of 2,500,000 fr.

Market Lighting.—The engineer of the Dewsbury Electricity and Tramways Department (Mr. R. W. Grubb) informs us that the whole of the stalls in the new portion of the town's market, eighty in all, have been equipped with electric lighting.

Business Education.—At the City of London College a number of evening courses are arranged for those engaged in business or commerce. Special instruction, with practical work, for students interested in certain classes of goods, such as iron and steel, general chemical manufactures, textiles, and so forth, is given.

N.S.W. Railway Electrification Contract.—It is reported that the Leeds Forge Co., Ltd., has received an order from the New South Wales Government for the supply of 50 steel coaches in connection with the electrification of the Sydney suburban lines.

LIGHTING AND POWER NOTES.

Aberdeen.—Loan Sanctioned.—The Electricity Committee has reported that, in connection with the application to the Electircity Commissioners for sanction to the borrowing of £154,578 for electricity purposes, the Commissioners have agreed to sanction the borrowing of £129,494. With regard to the amount of £24,834 included in the application for pump chamber and pumping plant, the Commissioners have decided to withhold sanction until the actual cost of the work is ascertained.

Breakdown.— The electricity supply was cut off for some considerable time on October 2nd owing to a mouse having got into the air gap between two 6,000-V cables. The main cables and much machinery were wrecked.

Andover.—Special Order.—The Western Electric Distributing Corporation, Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity to certain parishes in the rural district.

Blackburn.—Unemployment Relief Schemes.—The Electricity Committee proposes to erect a number of sub-stations in order to provide relief for the unemployed, and application is to be made to the Electricity Commissioners for sanction to borrow £40,000 for mains and sub-station work, and £7,500 for the installation of a new rotary converter at the Jubilee Street sub-station.

Blackpool.—Loan.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for sanction to the borrowing of £5,000 for meters.

Bradford.—Loans Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £12,360 for converting plant, switchgear, feeder mains, building work at Sunbridge Road, &c., and £15,700 for mains.

Carlisle.—Loan.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for sanction to a loan of £233,882 for a new generating station.

Carnarvon.—Electricity in Bulk.—In order to meet the increasing demand for electricity, the Town Council has arranged to obtain a bulk supply from the North Wales Power Co.

Continental.—Germany.—The Lower Isar River, which is comprised within the stretch from Landshut to the Danube, is to be harnessed. For this purpose a company has been formed, styled the Untere Isar Aktien-Gesellschaft, with a capital of 500,000,000 marks. The river has a 75-metre waterfall, its mean power yield being 100,000 h.p. The work will be carried out in stages, and the first two stations will be built at Landshut and Dingolfing respectively, with an output of 25,000 h.p. The first stage is expected to be completed within a year. The other stages will be carried out from the profits obtained from the first stage.

France.—The Paris, Lyons, and Mediterranean Railway Co. has applied for a concession to harness the flow of the water at Mont Lozère and erect a generating station, with a capacity of 20,100 h.p., at Pont-de-Montevert, with a view to the electrification of the Langogne to Alais railway. The plans include the building of a storage dam to hold 45,000,000 cubic metres of water.

The Société Anonyme de Verpenne has secured the concession for the distribution of electricity to the townships in the canton of Sissonne (Aisne department), and has already placed contracts for metal standards, copper, and

insulators. It is estimated that the cost of the network will amount to 1,500,000 fr.

The tender of the Société Anonyme des Exploitations Electriques for the electrification of the Région Langroise has been accepted for a sum of 5,900,000 fr., the estimate of the draft scheme having been 7,500,000 fr. The works are expected to be completed in 18 months.

The hydro-electric power station on the River Legué, near Belle-Isle-en-Tene, Côtes-du-Nord, was recently inaugurated. The plant has a capacity of 1,100 h.p.

Sweden.—The Waterfalls Board has submitted, for inclusion in next year's Budget a request for the appropriation of kr. 500,000 for work in connection with the construction of the power station at Lilla Edet, which will supply the electricity required for the Stockholm-Gothenburg railway. It is also proposed to allocate kr. 4,865,000 for work on a number of power stations now in course of erection.—*Reuter's Trade Service* (Stockholm).

Spain.—The Sociedad Electro-Metalurgica Iberica is perparing plans for the proposed hydro-electric works on the River Alberche, near Madrid. The power obtained will be considerable, and will be used mainly for industrial purposes.—*Reuter's Trade Service* (Madrid).

Dartford.—Loan Sanctioned.—The Urban District Council has received the sanction of the Electricity Commissioners to a loan of £11,000 for new plant at the electricity works.

Dronfield.—Electricity Supply.—The Urban District Council proposes to obtain a supply of electricity from the Sheffield Corporation, and is applying to the Electricity Commissioners for an Order authorising it to carry out a scheme.

Eastern Algeria.—Hydro-Electric Scheme.—A scheme is in hand for supplying electricity to the town of Constantine, the capital of Eastern Algeria, and also to the neighbouring towns. A dam is to be constructed at Kreneg, with a reservoir of 41,000,000 cu.m. capacity. It is estimated that 5,790 h.p. will be available, and an annual output of 25 million kWh is anticipated. The total cost of the scheme is 13,200,000 fr. Another dam is to be constructed, 130 ft. in height, with a canal 650 ft. long. The power available from this source will be 2,175 h.p., and the cost of carrying out the work is estimated at 7,000,000 fr. Electricity will be supplied to consumers at a rate of 0.171 fr. per kWh.—*Commerce Reports.*

East Retford.—Special Order.—The Corporation has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the borough and surrounding districts.

Gravesend.—Year's Working.—The report of the engineer of the combined Gravesend and Northfleet electricity undertakings (Mr. C. F. McInnes) for the year ended March 31st last shows a total revenue of £61,865, as compared with £66,788 in the preceding year. Working expenses absorbed £40,043, as against £47,157. The result was thus an increase in gross profit from £19,631 to £21,822. After the payment of capital charges, &c., there remained a net profit of £6,047, which was slightly less than that of the previous year—£6,380. The difference was due to higher charges in connection with the Northfleet undertaking. A sum of £3,500 has been contributed to the relief of the borough rates.

The generating statistics show that the sale of energy increased from 7,544,517 kWh to 10,590,509 kWh. The maximum load on the generating station rose from 2,250 kW to 2,760 kW, while the plant capacity was stationary at 3,400 kW. The extensions, which will make the station, the largest in Kent, are nearing completion.

India.—Pykara River Hydro-Electric Scheme.—An application for the sole right to develop electrical energy from the Pykara River in the Nilgiri Hills of South India has recently been made to the Government of Madras. It is proposed to construct a dam 150 ft. high across the river, forming a lake which will have a storage capacity of 6,000,000,000 cu. ft. The water from the lake will be conveyed by an aqueduct one mile in length, on the right bank of the river, to a forebay and from there through a pipe line to the power station situated at the bottom of the gorge. The project is so outlined that the tail water after use will be allowed to flow into the Moyer River. As the Moyer River flows through a deep gorge, the establishment of another power station is contemplated at a suitable point to generate electricity by the further fall of the river. A total of 50,000 h.p. is expected to be generated under the present scheme. The power obtained is to be utilised for electro-chemical industries, electrical reduction of ores, and for the supply of power and light to Calicut and other neighbouring towns.—*Commerce Reports.*

Isle of Wight.—Electricity Charges.—The County Council has received notice from the Ministry of Transport to the effect that orders have been made fixing the maximum charge for electricity supplied by the Isle of Wight Electric Light and Power Co., Ltd., at 10d. per kWh in Sandown, Shanklin, Newport, East Cowes, Cowes, and Carisbrooke. The charge in the Ventnor area remains at 1s. per kWh.

Liverpool.—Electrification of the Docks.—The electrification of the first section of the Northern docks has recently been completed at a cost of £250,000. Work in connection with the scheme was commenced in 1919.

London.—Fulham.—The Electricity and Lighting Committee recommends the reduction of the charge for outside shop lighting from £3 12s. to £2 10s. per annum. The scheme comprises the installation, maintenance, and renewal (when necessary) of a suitable lantern fitted with a 300-W lamp.

Maidenhead.—Loan Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £8,700 for mains and services.

Newcastle (Staffs.).—Electricity Supply.—The Town Council has entered into an agreement with the Knulton Manor Mining Co. for a supply of electricity. The estimated cost of laying the mains is £3,998.

Plymouth.—New Plant.—The Corporation has a number of schemes under consideration for unemployment relief, including the provision of new plant at the electricity works and mains, at an estimated cost of £169,160.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Abertillery.—Power: First 100 kWh per quarter, 5d. per kWh; next 100 kWh, 4½d.; next 100 kWh, 4d.; next 100 kWh, 3½d.; beyond, 3d. per kWh. Kinemas, theatres, &c.: First 2,500 kWh per quarter, 4½ per kWh; all energy in excess of this amount, 3d. per kWh, with a discount of 5 per cent. for prompt payment of accounts.

Dewsbury.—Lighting: From 7d. to 6½ per kWh. Power: Maximum demand rate: From 4½d. to 4d. per kWh for the first hour of maximum demand, and from .9d. to ¾d. per kWh beyond.

Trowbridge.—Charges reduced by from 1d. to 3d. per kWh, according to the quantity consumed.

Derby.—Lighting: 5½d. per kWh for the first 3,000 kWh per quarter and 5d. beyond.

Cardiff.—Lighting: From 5½d. to 5d. per kWh. Heating and domestic supplies: A reduction of ½d. per kWh, making the rates 1½d. per kWh for the winter quarters and 1d. per kWh for the summer quarters.

Ripley (Derbyshire).—Street Lighting.—At a recent meeting of the Urban District Council it was decided to accept the offer of the Derbyshire and Notts. Electric Power Co. to light the district at £4 15s. per lamp.

Sheffield.—Electricity Extensions.—Extensions to mains and distribution work are to be put in hand at an estimated cost of £4,855.

House Refuse as Fuel.—At the new refuse disposal works which were recently opened by the Corporation, cinders are being used to raise steam for generating electricity. Sufficient energy is generated to drive the whole of the machinery for charging the fleet of electric vehicles used for collecting refuse.

South Africa.—Bloemfontein.—According to the *British South African Export Gazette*, the Corporation is considering a proposal to erect a new power station, with a capacity of 7,000 kW. The estimated cost of the scheme is £180,000.

Sunderland.—New Plant.—In order to provide work for the unemployed during the coming winter, the Electricity Committee has a scheme in hand for the extension of the Hylton Road electricity works, including the installation of a 10,000-kW turbo-generator. The estimated cost of carrying out the scheme is £140,000, and application is to be made to the Government for a grant towards the scheme, owing to the work being carried out at an earlier period than was originally intended.

Thorne.—Electricity Supply.—It was reported at a recent meeting of the Rural District Council that a verbal agreement has been made by the Hatfield Main and Thorne Collieries and the Electrical Distribution of Yorkshire, Ltd., whereby the last will take the surplus supply of electricity from the collieries for distribution in the district. The maximum charge will be 7½d. for lighting, with a revision every three years. If the agreement is carried through it is anticipated that a supply will be available early next year.

Topsham.—Special Order.—Application has been made to the Electricity Commissioners by the Topsham Electricity Supply Co. for a Special Order authorising it to supply electricity in the district.

Torquay.—Street Lighting.—The Town Council has applied to the Electricity Commissioners for sanction to the borrowing of £1,500 for converting the street lighting from gas to electricity.

United States.—Hydro-Electric Development.—Plans are being prepared for the erection of a hydro-electric power station with a capacity of 150,000 h.p. on the Great Pigeon River, near Waterville, North Carolina. The dam will be 150 ft. high, and a tunnel is to be constructed five miles in length to the power station. The electricity will be transmitted to Ashville, N.C., and Knoxville, Tenn.—*Reuter's Trade Service* (New York).

Walton-le-Dale.—Electricity Order.—The Urban District Council is applying to the Electricity Commissioners for an Order to supply electricity in the district. It is proposed to negotiate with the Preston Corporation for the transfer of powers, if granted, at a later date.

Warrington.—Year's Working.—The accounts of the municipal electricity undertaking (engineer: Mr. F. V. L. Mathias) for the year ended March 31st last show a total

revenue of £98,470, as compared with £103,054 in 1921-22. The working expenses amounted to £46,885, as against £65,239, leaving a gross profit of £51,585 (£37,815). After the payment of capital charges, a net balance of £18,542 remained; the profit in the preceding year was £11,215. During the year the sum of £81,805 was spent on capital account, the principal items being machinery, tools, &c., £44,023; mains and services, £13,178; and buildings, £12,762. The number of kWh sold (excluding tramway supplies) rose from 8,019,814 to 11,423,984, reflecting the increase of the plant capacity from 7,750 to 12,000 kW. The maximum load was 5,870 kW, as against 5,413 kW.

Welshpool.—Electricity Supply.—The Welshpool Gas Co. proposes to apply to the Electricity Commissioners for an Order authorising it to supply electricity in the district, and has submitted the scheme to the Town Council for approval.

Wolverhampton.—Special Order.—The Corporation has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of electricity supply so as to include a number of parishes in the rural districts of Cannock and Seisdon.

TRAMWAY AND RAILWAY NOTES.

Bradford.—Railless Cars.—The Finance Advisory and Co-ordination Committee has approved the recommendation of the Tramways Committee for the construction at Thornbury depôt of six railless cars at an estimated cost of £10,800, and the scheme is to be submitted to the Ministry of Transport for approval.

Continental.—Spain.—The plans to construct an underground railway at Bilbao, of which the engineer, De José Ribero, is the promoter, include the laying of two main lines and the erection of 18 stations. Official sanction has not yet been announced.

Hellifield.—Light Railway.—A scheme is being prepared for the construction of a light railway from Hellifield to Longridge, a distance of about 20 miles, at an estimated cost of £200,000.

Liverpool.—General Manager's Report.—The report of the general manager of the city tramways (Mr. P. Priestly) covers the period of 15 months ended March 31st last. It shows that a total revenue of £1,941,613 was earned, and that the working expenses (including rental of leased lines) amounted to £1,575,176. Thus, the gross profit was £366,437. Interest and sinking fund payments absorbed £110,652, leaving a net surplus of £255,785. These figures represent a remarkable improvement in results as compared with the two previous years, when deficits totalling £81,653 were incurred. The undertaking has therefore been able to extinguish this loss and still have a balance of £174,132 to transfer to the reserve, renewal, and depreciation fund. The improvement has been effected in spite of (or because of) reductions in fares, which have made the system comparable for cheap transit with any other undertaking in the country. The running of "first-class" cars—a system peculiar to Liverpool—was discontinued in April last. The capital expenditure during the period amounted to £196,847; reconstruction of permanent way and electrical equipment accounted for £169,047, and cars for £27,303, the balance being expended on tools, &c. The traffic statistics show that 212,954,196 passengers were carried, and 18,047,484 car-miles run.

London.—Breakdown.—A failure of the electricity supply caused a stoppage of L.C.C. tramcars during the evening of October 5th. The main part of the dislocation occurred in the north and north-eastern districts.

Underground "Speed-up."—Improved services have been introduced on the underground railways. Additional and longer trains are being run in the rush hours. During the slack hours the Piccadilly Tube will run a 2½-minute service, and there will be a 2-minute service on the Central London line.

The Edgware Line.—Within a few weeks the first section of the new extension line from Golder's Green to Hendon will be opened for public service, and considerable progress has been made on the construction of line beyond Hendon, which will pass through Colindale and Burnt Oak to Edgware, a distance of three miles. The total cost of this new line from Hendon to Edgware, including permanent way, signalling, station buildings, rolling stock, &c., will be £598,200.

South Africa.—Railway Electrification.—It is reported that representations are being made to the Government to put in hand, as soon as possible, the second section of the railway electrification scheme, which includes the Cape Town suburban lines.—*Reuter's Trade Service* (Johannesburg).

Wakefield.—Tramways *v.* 'Buses.—Negotiations are said to be taking place between local authorities and the Yorkshire (West Riding) Electric Tramway Co., Ltd., with reference to the proposal of the company to abandon powers for the construction of tramways in the Wakefield district, as the company has instituted motor-'bus services instead.

TELEGRAPH & TELEPHONE NOTES.

China.—Canton-Hong-Kong Cable Duplication.—The Superintendent of the Telegraph Administration has been petitioned to have a separate telegraph line between Shameen and Hong-Kong installed so as to facilitate the transmission of telegraph messages, and to obviate the delay caused by the frequent breakdowns of the line between Canton and Hong-Kong. By restoring the former separate line between Shameen and Hong-Kong all messages, instead of passing through the head office, will pass between Shameen and Hong-Kong direct, and more messages can thereby be handled. —*Eastern Engineering.*

Germany.—Long-distance Radio Telegraphy.—In order to facilitate overseas traffic a receiving station has been installed at Geltow, about 30 kilometres in a southerly direction from Nauen. A similar arrangement has been adopted at Eilwese, the receiving station for which is now at Hagen. It is intended, says the *Scientific American*, to use the new stations for communicating with a distant station from Berlin, using Nauen for transmission and Geltow for reception, land lines connecting each of the latter with Berlin, and for communicating with New York, using the station at Rocky Point for transmission and that at Riverhead for reception.

New Bavarian Station.—It is claimed that after the completion of the new station, which the C. Lorenz Co. is constructing in the Upper Bavarian Alps, Germany will have the most powerful and best equipped radio station in the world. At first it will be devoted to experiments on a large scale, but later it will be operated by the C. Lorenz Co. for commercial and governmental purposes. One of the remarkable features of the new station, which is located in a shallow valley between the Herzogstand (1,732 m.) and the Stein, one of the foot-hills which rise above the Kochel Lake to a height of 940 m., is the manner in which the antennæ are placed. From the top of the Stein five aerial cables are stretched in fan fashion to five anchor points at the top of the Herzogstand, at an average height of 300 m. above the station building. The combined length of the five cables is about 2½ km. To prevent excessive strain on the aerials the insulated ends are attached to a single cable, which passes over a pulley at the highest point of the Stein. To the lower end of this cable a heavily weighted car is fastened, which rests on an inclined track on the farther slope of the hill. The ballast in the car is sufficiently heavy to keep the five aerials well stretched under normal conditions and to counterbalance their weight when they are exposed to strong wind or are coated with ice. In this way it is hoped that sagging of the antennæ will at all times be kept within permissible limits. For transmitting a Poulsen-Lorenz arc of approximately 2,000 kW and a high-frequency generator of the Schmidt type of equal capacity will be used. The electrical energy required will be obtained from the Walchen Lake power station nearby. The high-frequency will be obtained either directly from the generator or by a frequency transformer, as at Nauen. The equipment will render it possible to make, for the first time, a comparative test of the two methods of transmitting.—*Scientific American.*

Russia.—Radio-Telegraphy.—A translation of a decree of the Council of People's Commissaries of the Union of Soviet Socialist Republics, dated July 4th, 1923, and published in the *Izvestra* of September 12th, 1923, regarding the installation of radio stations by State, trade union, and communist party organisations in Russia, has been received by the Department of Overseas Trade from the British Commercial Mission, Moscow. The decree lays down the fundamental rules to be observed in connection with the construction and exploitation of radio stations for special purposes, which are stated to be industrial and commercial, stations for educational and scientific purposes, and amateur stations. The translation of the decree may be seen by United Kingdom firms on application to the Department of Overseas Trade.

Radio-Telegraphy on Ships.—Automatic Alarms.—Radio-telegraphy is to be discussed by a special committee of the International Shipping Conference which is to meet in London to-morrow. Automatic alarms are to be considered in place of human "watchers," and it has been recommended that, if necessary, the International Code should be altered for the purpose.—*The Times.*

The Telephone Service.—Hull Extensions.—Subject to the Finance Committee's approval, the Hull Telephone Committee has decided to apply to the Ministry of Health for sanction to borrow £33,700 for further telephones.

London's Automatic Exchange.—"Bishopsgate" is to be the first of the new automatic telephone exchanges in the City area. The present exchange of this name, which was opened some eighteen months ago, is temporarily housed in the "Clerkenwell" building, but plans have been completed for a new building in Little Pearl Street, E.C. Estimates for its erection are now being obtained, and the work should be started early in November.—*Financial Times.*

Public Call Boxes.—The Post Office is experimenting with new apparatus to enable people to use the ordinary call boxes for long-distance telephony. The box is designed to take silver as well as copper coins, so that almost any trunk call can be made from an ordinary call box. If the call is not effective, pressure of a button returns the money.

ALEXANDER RUSSELL, M.A., D.Sc., M.I.E.E.,

President of the Institution of Electrical Engineers, Session 1923-24.

In electing Dr. Alexander Russell to the presidential chair, the Institution of Electrical Engineers has honoured not only the man, but also the teaching profession—an event which occurs at only lengthy intervals. If we glance down the long list of past presidents, which forms a sort of historical preface to every list of members, we find that the last occasion of this kind was in 1909, when the chair was occupied by the late Gisbert Kapp; but the two cases are by no means truly parallel, for Kapp only adopted a university career after spending the greater part of his life in commercial engineering. We must, in fact, go back to the year 1899 for a really similar case, when the selection fell on the late Silvanus Thompson.

Of Faraday House, of which Dr. Russell is Principal, we need say very little in these columns. From small beginnings in the early days it has grown to a position of importance at the present time. It is identified with the "sandwich system" of training, and its roll of Old Students can boast of many who now occupy leading positions in the electrical industry.

Photo by] *[Elliot & Fry.*

Dr. Alexander Russell,
President of the Institution of Electrical Engineers.

Dr. Russell was born at Ayr, in Scotland, in 1861, and was educated at Glasgow High School. He obtained his M.A. degree in Glasgow University in 1882, and in the same year he gained the first prize in Lord Kelvin's Senior Natural Philosophy Class. He then went to Cambridge, where he was fourteenth wrangler in 1885.

This brief educational statement really gives the keynote to Dr. Russell's scientific work. Kelvin's interests were extraordinarily wide, but it may be said that he was chiefly attracted by the combination of physics and mathematics, the latter being used for the elucidation of the former. Such a combination can be extremely fruitful, but it is not often met with. In the case of Dr. Russell, the teaching of Glasgow and Cambridge fell on good ground, as is evidenced by his work on alternating currents, electrostatics, and similar subjects.

To illustrate this point in detail, mention may be made of Dr. Russell's advanced treatise on "Alternating Currents" (published in 1904), and his treatise on the "Theory of Cables and Networks." He has given much attention to the subject of the grading of cables to resist electric stress, and he was the first to point out the relations between the various capacities of the cores and sheath of a polycore cable, and to give an accurate definition of the capacity between two cores. In 1901 he devised the method of measuring the insulation resistance of a live network. It is only natural that harmonic analysis should have proved an attraction, and so we find that Dr. Russell devised novel graphical methods for this purpose. These are based on the evaluation of Fourier's solutions by means of the methods of mechanical quadrature given in books on the calculus of finite differences. He also devoted much time to methods of calculating the self and mutual inductances of coils of various shapes. One of his well-known pieces of work is the complete solution of the skin effect in a concentric main. Kelvin had given the solution in terms of what he called "ber" and "bei" functions; in giving the complete solution, Dr. Russell found it useful to define new functions, which he called the "ker" and "kei" functions in honour of Kelvin. Complete tables of these functions have now been published.

But to return to matters of history, as distinct from scientific effort: after completing his academic course, Dr. Russell became an assistant lecturer to Caius College, and subsequently a mathematical master at Cheltenham College and at the Oxford Military College. When the Faraday House Electrical Engineering College was started in 1890 he was appointed senior lecturer, and head of the physical laboratory. In the same year he married Edith, daughter of Mr. H. B. Ince, Q.C., M.P.; he has one son and one daughter. In 1908 Glasgow University conferred upon him the degree of D.Sc. On the death of the late Hugh E. Harrison, he was appointed Principal of Faraday House.

Dr. Russell's knowledge of Kelvin enabled him to deliver the Kelvin Lecture before the Institution of Electrical Engineers in 1916, with some of those personal touches which are necessarily becoming more and more rare in these discourses as time goes on. He has also written a short biography of Kelvin. Dr. Russell has been prominently identified with both the Institution of Electrical Engineers and the Physical Society of London, and he will be actually serving as president of both these bodies during the coming session—a unique event. His papers have appeared frequently in the transactions of both, as well as in those of the Royal Society and in the *Philosophical Magazine*.—His contributions in this direction are more purely physical, but still of technical importance. Thus, his formula for calculating the maximum potential gradient between spherical electrodes is well known. Dr. Russell's papers to the Royal Society have mostly been in connection with Poisson's problem of two electrified spheres, and a complete and greatly simplified solution of this problem was read before the Physical Society last year. His simple methods for calculating the capacities between spherical

electrodes and the capacity of a spherical condenser when the inner sphere is not concentric with the outer are kindred subjects. A different line of work is his theoretical verification of Kennelly's experimental result that the convection of heat from a thin wire varies inversely as the square root of the radius of the wire and directly as the square root of the velocity of the cooling breeze. He pointed out that Newton's law of cooling—that the heat convected was proportional to the difference of temperature between the body and the cooling breeze—was very approximately correct in all cases.

Activities in a purely technical direction include two lengthy series in the *Builder*, one on "Electrical Engineering" and the other on "Electric Heating and Lighting"; and a translation into English of Prof. Buchetti's book on "Engine Tests and Boiler Efficiencies."

Those who come into close contact with Dr. Russell know him as a hard worker, who nevertheless always has some time to spare. We are sure, therefore, that the affairs of the Institution will receive adequate attention at his hands. And those who have sat with him at Council tables know that he possesses a balanced judgment that is not readily swayed by the cross-currents so often found in such deliberations. With his students, both past and present, Dr. Russell is deservedly popular. To the former he is readily accessible and helpful in their difficulties, as counsellor and friend; to the latter he is helpful in no less degree, and his quiet sense of humour, so important in anyone engaged in serious teaching, maintains without friction a degree of easy discipline among the recruits of our profession. We fancy that the reception of the Doctor when he rises to speak at the next dinner of the Old Faradians will be even more vociferous than usual, by reason of his present honoured position.

THE BOLTON ELECTRICITY UNDERTAKING.

Inauguration of New Plant.

The Bolton Corporation commenced to supply electricity within the municipal limits of the borough in October, 1894, from the Spa Road generating station on the a.c. single-phase system, the generated pressure being 2,000 volts, which was transformed down in sub-stations or on consumers' premises; this system is still being extended on the outskirts of the town.

In November, 1899, a d.c. system was initiated to supply the tramways and for industrial purposes in the centre of the town. The two 160-h.p. and one 80-h.p. original reciprocating sets were added to from time to time, until, in 1912, it was found that the Spa Road station, containing about 7,600 kW of plant, was loaded beyond its economic capacity, especially as the conditions then called for a.c., 3-phase, 6,600-volt plant. Accordingly, a new station, involving the expenditure of £130,000, was commenced in 1913 at Back-o'-th'-Bank, the first turbo-generator being placed in commission in September, 1914.

The initial plant installed at the new station consisted of two 4,000-kW, 6,600-volt, 50-cycle, 3-phase turbo-generators delivering energy at this pressure through the main switchboard, into trunk feeders coupled to the existing cable network supplied from Spa Road.

Fig. 1.—Switchgear Control Gallery.

The boiler-house contained four water-tube boilers, generating steam at 200-lb. pressure, and each capable of supplying 34,000 lb. of steam per hour. The original equipment included water-storage reservoirs, coal-handling plant and the usual auxiliary machinery. It

was soon found to be necessary to extend the generating plant, and the low generating costs of the new plant

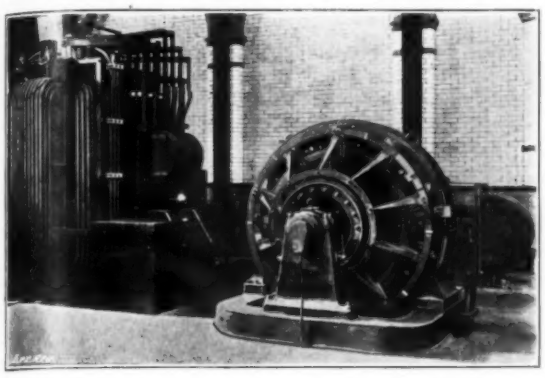

Fig. 2.—A 1,500-kW Rotary Converter.

justified the shutting down of the original Spa Road works entirely, and generating the whole supply at Back-o'-th'-Bank.

This necessitated installing converting plant at Spa Road, which then became a sub-station and involved developing Duncan Street sub-station, and erecting a new sub-station at Bradshawgate, the transforming and converting plant enabling the existing distributing mains throughout the town to be used as before.

In 1917-18 an 8,000-kW turbine, together with two boilers and auxiliaries, were added to the station at a cost of about £80,000. This addition did not suffice for very long, and in 1919 the Electricity Committee launched another scheme to still further extend the Back-o'-th'-Bank buildings, reservoirs, and machinery, involving an expenditure of about £820,000, resulting in an increase to the plant capacity of 30,000 kW. When completed, Back-o'-th'-Bank generating station will have a plant capacity of 46,000 kW. The results so far obtained have been most satisfactory, and in spite of the price of coal having increased from 10s. to 18s. 6d. per ton, or 85 per cent., the cost per kWh sold at March 31st last was 0.255d., as against 0.354d. in 1913, showing a reduction of 28 per cent.; in fact, the total working costs at March 31st last were 6 per cent. lower than at March 31st, 1913, in spite of the increased costs, as compared with pre-war prices.

The Back-o'-th'-Bank site has an area of 7.8 acres, and is bounded on the west by the Astley Bridge branch of the L.M. & S. Railway and by the River Tonge on the east.

Fig. 3 shows the turbine room, which contains six turbines of different sizes and makes, each coupled direct to a generator and exciter. Nos. 1 and 2 sets consist of the Musgrave turbines and condensers and Dick, Kerr 4,000-kW generators installed in 1914; No. 3 set, installed in 1917, is an 8,000-kW British Thomson-Houston machine with Hick, Hargreaves condensing plant; No. 4 set, installed in 1921, is a Willans and Robinson turbine, with a Worthington-Simpson condenser, driving a 6,000-kW General Electric generator; No. 5 set, installed in 1922, consists of an Escher-Wyss turbine, Hick, Hargreaves condenser, and a 12,000-kW Metropolitan - Vickers generator; while No. 6 set, which is illustrated in fig. 4 and was the subject of the inaugural ceremony yesterday week, is a 12,500 - kW English Electric turbo-generator with Hick, Hargreaves condensing plant.

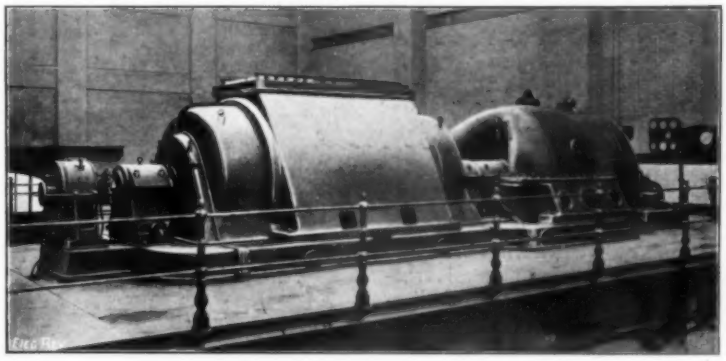

Fig. 4.—English Electric 12,500-kW Turbo-Generator.

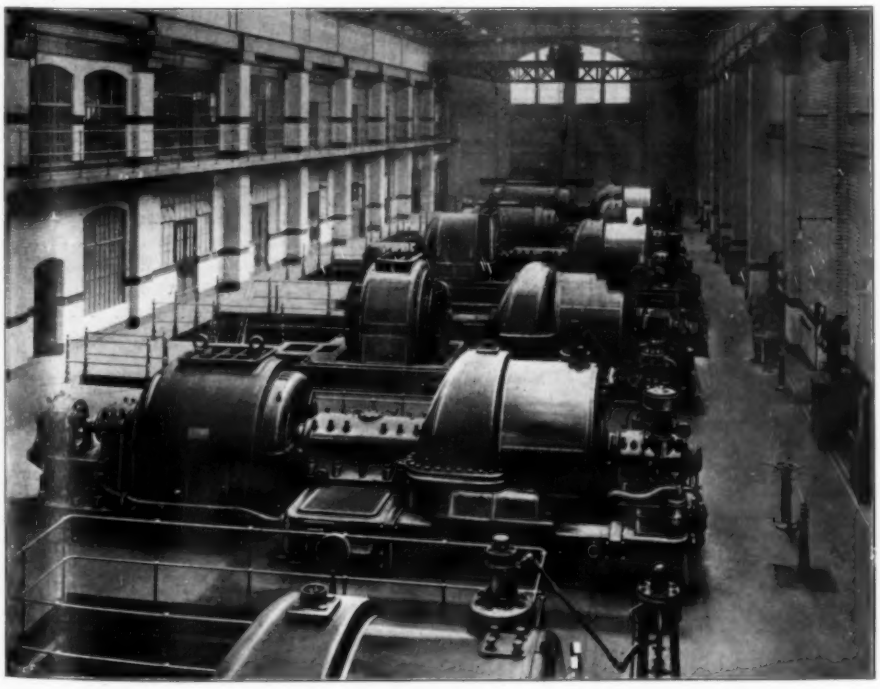

Fig. 3.—Turbine Room—Capacity 46,000 kW.

Each generator is provided with a filter for cleansing the cooling air. The auxiliary machinery is electrically driven, although steam turbine - driven stand - by auxiliary plant has been provided for the two largest sets in the station.

The water for condensing purposes is taken from the River Tonge and, in addition, reservoirs have been provided capable of storing about 7½ million gallons of water. Spray water-cooling plant, fig. 7, is available in case of water shortage, and the water taken from the

river is led through culverts into the reservoirs after passing through rotary water screens for cleaning purposes, fig. 7, and after being used for condensing

Fig. 5.—Boiler House.

purposes it is returned to the river. Coal is delivered in railway trucks on to a private siding off the Astley Bridge branch railway. A rotary tippler empties the wagons into a main bunker of 500 tons capacity, and a weighbridge is provided to weigh the trucks in and out of the siding. The main coal bunker and the connecting bridge to the railway siding form a steel structure about 52 ft. above the boiler-house firing-floor level, fig. 6. The coal is conveyed from the main bunker by means of bucket and gravity conveyors, capable of dealing with 60 tons per hour, into 50-ton capacity secondary bunkers placed over each boiler, whence it is delivered through chutes into the stoker hoppers, the amount delivered to each boiler being automatically weighed. The clinker and ashes fall over the end of the grates into hoppers, and are then removed by means of suction plant into a main coal bunker, fig. 6.

Water-tube land-type boilers of standard design, fitted with superheaters and manufactured by Messrs. Babcock & Wilcox, Ltd., are used, fig. 5. Their working pressure is 215 lb. per sq. in., and the steam is super-

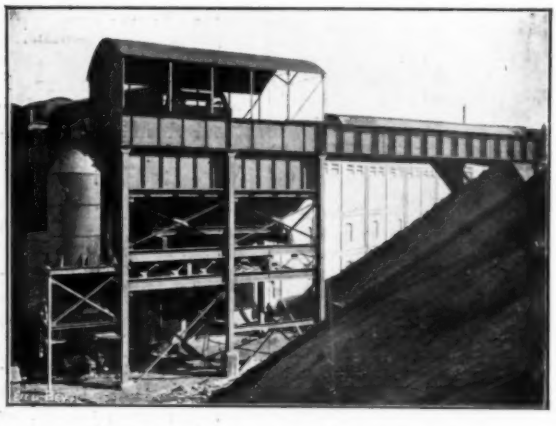

Fig. 6.—Coal- and Ash-Handling Plant.

heated 150 deg. F. The rated duty of each boiler is 34,000 lb. of steam per hour, and there is 9,273 sq. ft. of heating surface per boiler, with 180 sq. ft. of grate area; separate motors drive the two stokers on each boiler. There are 12 boilers, and provision has been made for a further six to be installed as required.

Each boiler has its own economiser of 336 tubes, manufactured by Messrs. E. Green & Sons. They are erected on a separate floor immediately over the boilers, and at the back of the economisers there is a main flue connecting each side of the boiler house to its respective chimney. There are two chimneys, each 250 ft. high and 11 ft. 6 in. bore, which have been designed to operate the boilers on natural draught, but induced-draught fans can be added at a later date if found necessary.

The boilers are fed by means of rotary water pumps, electrically and steam driven. The condensed steam from the main turbines flows into two tanks which feed the pumps, and the make-up water is supplied from the town's mains after passing through a water evaporator in order to eliminate any scale-forming matter it may contain. A central pump room is provided between the boiler and the turbine houses, and this space also contains the main steam range which runs the whole length of the works.

The main switchgear is electrically remote controlled, and it was supplied by the Metropolitan-Vickers Electrical Co., Ltd. The 6,600-volt cubicles are in a switch-room on one side of the turbine house, and the whole of the control gear, fig. 1, has been placed on the floor immediately above. The generator switchgear is

Fig. 7.—Water Screens and Spray Cooler.

divided into groups, so that each generator can be separated to supply an isolated group of feeders from the station to the several sub-stations. The main switchgear is again divided into two sections, the generator cubicles being separated from the feeder switchgear and interconnected through group switches.

The control gallery also contains the whole of the switchgear for operating the auxiliary circuits and a storage battery, situated in the basement, is provided for operating the remote-control gear.

The electricity generated at 6,600 volts is transmitted at this pressure to three main sub-stations which form a triangle, and are arranged to interconnect by means of high- and low-pressure mains. The supply pressure to the ordinary lighting or power consumer is 230 and 460 volts d.c., or 100 and 200 volts a.c., single-phase, 50 cycles, and to the large power consumer it is 400 volts, three-phase, 50 cycles; the tramway supply is 500/550 volts direct current.

The Spa Road sub-station is equipped with:—Two 300-kW motor generators, three 1,000-kW and one 1,500-kW rotary converters, one of the latter being illustrated in fig. 2. The sub-station also contains a 3,000-ampere-hour battery, together with sundry boosters and balancing plant. Extensive alterations have been made at Spa Road, and new switchgear has been installed to replace obsolete gear.

The Duncan Street sub-station is equipped with:—Three 600-kW and one 800-kW rotary converters. This sub-station has also been extended, and a scheme is in hand to replace the existing e.h.p. switchgear with gear of larger sections, and also to supply the tramway system from this sub-station.

The Bradshawgate sub-station is equipped with:—Two 600-kW and one 300-kW rotary converters.

In conclusion, it may be stated that the number of consumers is now 7,657; kW connected to the mains, 42,502; number of kWh sold in 1923, 38,279,725, or 2,984,913 for lighting, 6,455,944 for tramway, and 28,838,868 for power purposes. The plant capacity is now 34,000 kW, the maximum load on the feeders being 17,870 kW.

On October 4th members of the Town Council were afforded an opportunity of visiting the various departments of the electricity undertaking and of witnessing the remarkable growth which has taken place in the concern during recent years. The visit was arranged to mark the completion of the extensions at Back-o'-th'-Bank, the culminating event in the execution of the scheme of development planned many years ago by Mr. W. J. H. Wood.

Assembling at the Town Hall, the visitors were first conveyed to the Spa Road works, and after seeing the converting plant there, proceeded to the Back-o'-th'-Bank generating station, calling *en route* at the Duncan Street sub-station and the Knowsley Street showrooms, an establishment replete with everything in the shape of electrical domestic appliances. Arriving at Back-o'-th'-Bank, a tour of inspection was made of the works, in the course of which the new 12,500-kW turbo-alternator was started, the ceremony being performed by Councillor R. E. Roberts, chairman of the Electricity Committee.

We are indebted to Mr. W. J. H. Wood, borough electrical engineer, for his assistance in the preparation of this article.

RADIO NOTES.

Irish Free State.—Radio-Broadcasting.—Answering a question in *Dail Eireann*, the Postmaster-General said that negotiations for the establishment of a broadcasting station in the Free State were in progress.

Jugo-Slovakia.—New Radio Stations.—The Serbo-Croat-Slovene Minister of Posts ordered during the past year from the Telefunken Co. in Germany and from the firm of Lorenz six radio stations, which will be set up at Lubiana, Zagabria, Spalato, Podgoritza, Novidal, and Skoplije. The largest is that of Lubiana, which, with those of Zagabria and Skoplije, will be constructed by the firm of Lorenz. It will be of a power of 40 kW and will use wave-lengths of 4,150, 5,350, 7,300 and 12,000 metres. The antennæ, supported by a central metallic tower 120 metres high, will be in the shape of an umbrella. Those of the stations of Zagabria and Skoplije will be of arc shape and will use wave-lengths of 3,000 and 8,000 metres. They will also be modifiable for radio telephony with wave-lengths of 3,500 and 4,000 metres. The receiving stations will be located several kilometres from the transmitting stations and furnished with T antennæ. The three remaining stations, supplied by the Telefunken Co., will be of 20, 10 and 5 kW respectively, and will also be capable of being used for radio telephony.—*L'Elettricista.*

Radio Antennæ.—New Type of Wire.—A new antenna cable recently developed has shown that by its use the audibility of signals can be increased by nearly 40 per cent., says the *Scientific American*. The conductor is composed of ten strands of No. 18 bare copper wire braided closely together on a special machine to give it a ribbon-like appearance, ¾ in. wide by ⅛ in. thick. With an antenna 30 ft. long of this type, strung in a basement at a level about 1 ft. below the surface of the earth, better results were obtained, it is claimed, than with an antenna of the usual type, of 100 ft. length, strung between two poles out of doors at an elevation of about 40 ft.

Radio-Broadcasting.—New B.B.C. Agreement.—An extraordinary general meeting of the British Broadcasting Co., Ltd., was held at the Cannon Street Hotel on the 9th inst. for the purpose of approving, if thought fit, the terms of the agreement arrived at between the Postmaster-General and the directors.

Lord Gainford, who presided, announced that the British Broadcasting Co. had made representations to the Postmaster-General urging that on the subject of protection for British industries the report was by no means satisfactory. He explained that had it been possible to secure the immediate passage of a protective measure through Parliament to "keep the foreigner out," the report might have been adopted as it stood; they had had to do the next best thing. To offset the loss that had been suffered in the last few months they had endeavoured to secure an extension of their licence beyond the end of 1924, but the Postmaster-General could not agree. Up to October 13th 32,000 persons had applied for constructor's licences. A resolution enabling dealers to become members of the British Broadcasting Co. under certain conditions, and making certain technical alterations in the Articles of Association, was passed.

Instructional Installations.—The number of London County Council schools provided with radio apparatus for instructional purposes is now 25.

New Station.—The new station of the British Broadcasting Co. at Aberdeen was to be opened on the 10th inst.; it will have a wave-length of 495 m. instead of 360, as originally announced.

South Africa.—New Radio Station.—According to the *British South African Export Gazette*, a site has been decided upon for the long-distance radio station which is to be completed in fifteen months. Work will shortly begin close to Klipheuval station, in the Malmesbury district of the Union, and sixteen masts are to be erected in a circle 1½ miles in diameter. The new station will use 750 kW, as compared with the 5 kW used by the station at Slangkop in the Cape Peninsula, and direct communication will be possible with England, Australia, India, the United States, &c.

Wireless Retailers' Association.—Broadcasting Committee's Report.—After a recent meeting of the Committee of this Association a statement was issued strongly approving the report of the Broadcasting Committee and disapproving the rejection of some of its most vital recommendations: "The Committee of the Association deplores the continuance of the pernicious system of royalties, and fails to see that the Telegraph Act of 1904 confers any authority on the Postmaster-General to prohibit the importation of radio apparatus for the purpose of protecting one section of the trade at the expense of the public. It furthermore entirely endorses the view of the Broadcasting Committee that the question of protection involves the fiscal policy of the country and is of opinion that a government department has no power to determine the issue between free trade and protection."

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the* Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)

OPEN.

Argentina.—Buenos Aires.—November 2nd. State Railways. Electrical material (specification 15.00 pesos, paper). The Department of Overseas Trade states that it has not received any further particulars.

Australia.—Sydney.—December 12th. City Council. New South Wales Government Railways and Tramways. Rotary converter sets.*

January 21st. H.p. split conductor feeder panels.*

October 18th. Postmaster-General's Department. Protective apparatus.*

November 1st. Telephone apparatus and parts.*

Melbourne.—January 3rd. Victorian Electricity Commissioners. Aluminium steel-cored cable and accessories. (See this issue.)

December 15th. Four 1,000-kVA single-phase transformers and spares. (See this issue.)

Barking.—October 22nd. County of London Electric Supply Co., Ltd. Construction of a tunnel under the River Thames at Barking in connection with the new power station scheme. Specification from Sir Alexr. Gibb & Partners, Queen Anne's Lodge, S.W.1.

Belgium.—October 25th. The Ingénieur en Chef, Directeur des Ponts et Chaussées, 52, Boulevard Regent, Brussels. Electrical equipment of the static transformer stations at the new barrage locks on the Upper Scheldt at Asper, Audenaerde, Berchem, Espierres, and Kain. Particulars from 15, Rue des Augustins, Brussels.

November 10th. The municipal authorities of Saint-Gilles-lez-Bruxelles. Cast-iron terminal boxes, complete with circuit breaker, also junction boxes, &c. Particulars from the Service de l'Electricité, 40, Rue de Bethléem, Saint Gilles, Brussels.

Blackpool.—Electricity Department. H.p. and l.p. paper-insulated lead-covered armoured cables. (October 5th.)

Canada.—Toronto.—October 23rd. City Council. One horizontal centrifugal pump, direct coupled to 220-V, 3-phase motor, &c.*

Dover.—November 12th. Electricity Department. About 8 miles e.h.p. 3-core paper-insulated cables. (See this issue.)

Glasgow.—October 29th. Parish Council and District Board of Control. Stores, including electric fittings and lamps, for the various hospitals for six months. Forms, &c., from Inspector and Clerk, 266, George Street.

Huddersfield.—Electrician's work for first eight houses of proposed 150 houses, Moldgreen. Particulars from H. Myers & Co., Lister Street, Moldgreen, Halifax.

Irvine.—October 20th. Town Council. Lighting work in 12 houses. Specifications, &c., from Joint Town Clerks, Council Chambers.

Italy.—Porto Maurizio and Oneglia.—October 31st. Municipalities. Construction and operation of an electric tramway between Porto Maurizio and Oneglia (about 4 miles).*

Leek.—October 17th. Electricity Department. One 400-kW, d.c. generator and one open-type cooling tower. (October 5th.)

Liverpool.—October 19th. West Derby Board of Guardians. Twenty electrically-heated warming cupboards. Clerk to West Derby Board of Guardians, Union Offices, Brougham Terrace, Liverpool.

London.—London County Council.—October 15th. Single and double pole track and test panels. (September 21st.)

H.M. Office of Works.—October 19th. One 3,000-V, 3-ph. motor and compressor, &c. (October 5th.)

New Zealand.—Wellington.—Public Works Department. November 20th. Portable testing instruments for Mangahao power plant.*

December 4th. Metering equipment.*

December 11th. Transformers for the Waikato power scheme. Outdoor- and indoor-type apparatus for the sub-station at Penrose, Auckland.*

Nottingham.—October 19th. Electricity Department. One 25-ton overhead travelling electric crane. Specifications from Messrs. Preece, Cardew & Rider, 8, Queen Anne's Gate, S.W.1.

Pentre, Glam.—October 17th. Rhondda Urban District Council Electricity Committee. 100 yd. 19/.083 (.1 sq. in.) e.h.p. single insulated lead-covered cable and 100 yd. 1.25 sq. in. l.p. single v.i.r. lead-covered cable. (See this issue.)

Reading. — November 3rd. Corporation. Complete equipment of an air-compressing station at Manor Farm, Reading, consisting of e.h. and l.p. switchboards and motors, transformers, air compressors, piping, valves, cables, measuring apparatus, cooling tank, &c. (October 5th.)

Rochdale.—Newhey Industrial Co-operative Society. Installing electric light in central premises. Specifications, &c., from secretary.

Skipton.—October 22nd. Urban District Council. Wiring and fixing electric light fittings in Town Hall and offices. Mr. A. E. W. Aldridge, Council surveyor.

Salford.—October 16th. Board of Guardians. Distributing boards and electric cables for 10 motors and 4 ventilating fans; fuses, switches, and fittings, including enamelled shades for 56 lights, in addition to 8 plugs for hand lamps, for new laundry at Hope, Pendleton. Mr. E. H. Inchley, Clerk to Guardians, Poor Law Offices, Eccles New Road, Salford.

South Africa. — Johannesburg. — November 1st. H.p. cubicles.*

Stoke-on-Trent.—November 14th. Electricity Department. E.h.p. and l.p. switchgear for transforming sub-station, Marsh Street. (October 5th.)

Watford.—October 15th. Town Council. Wiring 40 houses for electric lighting. Mr. D. Waterhouse, borough engineer.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Three concerns—one each Belgian, French and Czecho-Slovakian—competed last week for the contract for the supply and erection of telephone cables at Andenne, Binche, Chatelineau, Courcelles, Fontaine-l'Eveque, and Gosselles for the Belgian Post and Telegraph authorities. The lowest offer was that of the home concern, the Société des Ateliers de Constructions Electriques de Charleroi.

Blackburn.—Town Council. Accepted:—
Electrical work at the Free Library.—Messrs. Renshaw & Marsden.

Bradford.—Tramways Committee.
200 1-piece steel tramway poles (£1,741).—British Mannesmann Tube Co., Ltd.
24 pairs steel points and special trackwork (£3,531). Six sets of points and crossings for temporary track (£531).—Hadfields, Ltd.
48 sets of steel gear wheels and pinions (£535).—Alfred Wiseman, Ltd.

Electricity Committee.
Works in connection with transformer chamber at Carrbottom Road, Wibsey (£495).—J. & P. Obank.
Work in connection with Nos. 1 and 5 cooling towers, Valley Road works (£920).—Davenport Engineering Co., Ltd.

Education Committee.
Installation of electric lighting at school clinic, Great Horton Road.—A. Ridgway & Co.
Lighting installations at Hepworth Wesleyan Chapel and schools, and at Mount Stead, Ben Rhydding.—Harry Moss.

Brazil.—The State of San Paulo has placed the contract for the electrification of the Campos Jordao Railway with the English Electric Co., Ltd.—*Americana.*

Chesterfield.—Bolsover Colliery Co.
Two electric winders.—British Thomson-Houston Co., Ltd.

Canada.—A contract for a new dam and power house and for the installation of equipment for the production of 25,000 h.p. has been awarded by the Hollinger Consolidated Gold Mines to Sir William Arrol & Co., Ltd.—*Reuter's Trade Service* (Toronto).

Doncaster.—Town Council. Accepted:—
H.p. switchgear for controlling new rotary converter (£280).—Reyrolle and Co., Ltd.

Dublin.—Corporation. Twenty-one tenders were received for the electric wiring of 332 houses on the Fairbrother's Field site, Dublin. That of Mr. F. E. Smith, Dublin, was accepted.

Edinburgh.—Tramways Committee. Accepted:—
Eight car bodies.—Bristol Wagon and Carriage Works Co.

Gillingham (Kent).—Town Council. Accepted:—
150-kW transformer for sub-station (£144).—Hackbridge Transformer Co.

Glasgow.—Tramway Committee. Recommended:—
Trolley wire.—British Insulated & Helsby Cables, Ltd.
Gear wheels.—A. Wiseman, Ltd.
Pinions.—Gears (Glasgow), Ltd.
Boiler drums for Pinkston.—Babcock & Wilcox, Ltd.
Coil-forming machine.—Midland Dynamo and Motor Repairs Co., Ltd.

India.—*The Times* states that Messrs. Glenfield & Kennedy have just secured, against keen competition, an important barrage contract from the Irrigation Department of the Government of India, the value of which is nearly £80,000.

Kingston-on-Thames.—Board of Guardians. Accepted:—
Lift (£739).—Medway's Safety Lift Co., Ltd.

Leeds.—Electricity Committee. Recommended:—
Switchgear (£19,300).—A. Reyrolle & Co., Ltd.

Maidenhead.—Town Council. Accepted:—
Balancer for the electricity works (£325).—Baxter & Caunter, Ltd.

Malvern.—Urban Council. Accepted:—
Superheaters for 2 Lancashire boilers.—Supeheater Units, Ltd.

Newcastle-under-Lyme. — Electricity Committee. Accepted:—
Cable and laying (£3,998).—Callender's Cable and Construction Co., Ltd.

Shropshire Power Co.—Work has been commenced by the Shropshire, Worcestershire, and Staffordshire Electric Power Co. on its new 150,000-kW power station situated on the River Severn, Stourport. Contracts have been let with the British Thomson-Houston Co., Ltd., for the turbo-alternator; Messrs. Cole, Marchent & Morley, for the condensers; British Insulated & Helsby Cables, Ltd., for 16 miles of 33,000-V h.p. cable; and Messrs. Stewart & Co., for cooling-water intake and outlet culverts, pile driving, and ferro-concrete work of the raft of the power station. Contracts have also been placed for the supply of Stirling boilers of 60,000 lb. normal capacity to work at 350 lb. per sq. in.

Sleaford.—Urban Council. Accepted:—
Extensions of mains, all the material used to be of English make (£1,575).—Callender's Cable and Construction Co., Ltd.

Torquay.—Town Council. Accepted:—
Steam, feed, blow-down, and drain piping for Newton Abbot power station (£1,765).—Aiton & Co.

FORTHCOMING EVENTS.

Institution of Electrical Engineers.—Thursday, October 18th. At the Institution, Savoy Place, W.C.2. At 6 p.m. Inaugural address by the President, Dr. A. Russell.

(Western Centre).—Monday, October 15th. At the South Wales Institute of Engineers, Park Place, Cardiff. At 6 p.m. Inaugural address by the Chairman, Mr. C. T. Allan.

(East Midland Sub-Centre).—Tuesday, October 16th. At Loughborough College. Paper on "Pneumatic Handling of Coal and Heavy Material," by the Chairman, Mr. E. G. Phillips.

(Sheffield and District Sub-Centre).—Wednesday, October 17th. At the Royal Victoria Hotel, Sheffield. Chairman's (Mr. E. Cross) address and smoking concert.

Faraday House Old Students' Association.—Friday, October 19th. At Hotel Cecil. At 6.30 for 7 p.m. Annual dinner.

Edinburgh Electrical Society.—Friday, October 19th. At the Philosophical Institute, 4, Queen Street. At 8 p.m. Paper on "Heating and Cooking," by Mr. M. Leak.

Junior Institution of Engineers.—Friday, October 19th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "The Gas Boiler," by Mr. F. W. Dye.

Institution of Railway Signal Engineers.—Friday, October 19th. At the Hotel Great Central. Annual dinner.

Institution of Mechanical Engineers.—Friday, October 19th. At the Institution, Storey's Gate, S.W. At 6 p.m. Presidential address by Sir John Dewrance.

Electrical Power Engineers' Association (Southern Division).—Saturday, October 20th. At the Hotel Cecil. Annual dinner. At 5.30 for 6 p.m.

RECONSTRUCTION ORDERS FROM JAPAN.

There is increasing evidence that the needs of Japan in connection with her reconstruction measures will be very large, and that the co-operation of British and other industrial and trading concerns will be desired. It is of course to be supposed, as Sir Edward Crowe (British Commercial Counsellor to Japan) told a meeting of the Federation of British Industries on Tuesday, that there will be keen competition, but that circumstance notwithstanding, British firms should receive a lot of business, especially for steel work, galvanised sheets, and motor lorries, and, we may add, electrical installation material of various kinds. We have already published (Elec. Rev., Sept. 28th, p. 450) a list of selected items which under the Imperial Ordinance are to be exempted from import duty or to have the duties reduced by one-half until March next so as to facilitate the import of reconstruction materials. In view of the needs of the market and bearing in mind the desire of Japanese traders for a knowledge of sources of essential products, we are dispatching a large number of additional copies of the Electrical Review for next week (October 19th) to electrical engineers and contractors in the principal cities in Japan. We are doing this with the kind assistance of the Japanese Consul-General in London. The Electrical Review has for many years had a large reading public in Japan, but the supplementary specialised circulation which has now been arranged for will bring the notices of manufacturers and their products especially before the eyes of others who are practically certain to be buyers of British goods suitable for the present emergency.

We may add that a report has been prepared by the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, on the Osaka market for building materials. This comprehensive description presumably includes various electrical lines, and as the report includes the names of importers of building materials in Osaka, it should be of value to British exporters.

NOTES.

The International Conference of Bibliography and Documentation.—This conference took place at Brussels on the 12th, 13th and 14th of September. Its efforts are directed to the methodical classification of scientific, technical, commercial, and administrative documents. According to the *Revue Générale de l'Electricité*, the bibliography of science and engineering is the special concern of the Bibliographic Bureau of Paris, under the direction of General Sébert. Great difficulties are met with owing to the cost of communication with the various interested bodies, the resources of the International Institute of Bibliography being meagre. The value of its work is widely recognised, and the view was expressed by the delegates that the space occupied by its collections in the Palais Mondial, Brussels, where they have been housed since 1905, should be retained for its use, in spite of a proposal that had been made to hold a rubber exhibition there.

Empire Mining and Metallurgical Congress.—An Empire Mining and Metallurgical Congress is to be held at the British Empire Exhibition in London during the first week of June, 1924. The Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Institution of Petroleum Technologists, the Iron and Steel Institute, and the Institute of Metals, representing the scientific and technical interests of the mineral and metal industries, with the Mining Association of Great Britain and the National Federation of Iron and Steel Manufacturers, are co-operating as conveners of the Congress. —*Engineer.*

Electricity Supply at Hornsey.—An inquiry was opened on the 8th inst. at Hornsey Town Hall by Colonel T. C. Ekin, Chief Engineering Inspector of the Electricity Commissioners, with regard to an application by the Hornsey Corporation for the consent of the Commissioners, under Section 11 of the Electricity (Supply) Act, 1919, to an extension of the generating station by the Corporation. The question at issue was whether the Corporation was to be allowed to continue to generate electricity or whether it was to be compelled to take a bulk supply from a power company as regarded the whole or part of the electricity required.

Mr. R. M. Montgomery, K.C., in explaining the application, said that last year, at the desire of the Electricity Commissioners, an agreement was arrived at between Hornsey and Finchley by which each should assist the other, and they had been linked up with that object in view.

In July, 1921, an application made by Hornsey for certain extensions to be sanctioned was inquired into by the Commissioners, who concluded that it would be cheaper for Hornsey to extend its plant than it would be for Hornsey to take a supply in bulk from the North Metropolitan Co. Consent being given, the extensions were made. The applicants could prove that by extending their plant in the way proposed they could supply electricity in Hornsey at a lower rate than if they were bound to take a bulk supply from the North Metropolitan Co. The extensions would cost £38,500; but they did not think the money would be wanted before 1931. If local authorities were not allowed to increase their generating plant, in a few years they would be in the hands of private companies.

Mr. Arthur Collins, financial adviser to local authorities, Westminster, submitted a statement of comparative costs. From 1925 to 1930, when the work contemplated would be completed, local generation would result in a saving to Hornsey of £21,354. In 1930 alone it would amount to £5,986. In 1931 a large expenditure of new capital would take place, but would not destroy the advantage that Hornsey held in the cost of its supply. That advantage would remain with Hornsey up to 1940. His figures were exclusive of the linking-up scheme with Finchley, which in itself would save at the rate of £1,700 a year for the next four years. The business of supplying electricity had been conducted on sound lines, and Hornsey Council was right in further reducing its charges.

Replying to Mr. Craig Henderson, K.C., who appeared for the North Metropolitan Power Co., the witness agreed with the arrangement made to supply Hampstead from an outside authority, because of the quantity required—six million, as against two million units. If Hornsey required six million units he would have to form an entirely different estimate of the cost of local generation.

Mr. Arthur H. Seabrook (partner in Sir Charles Bright and Co., consulting engineers) stated that there was an urgent need for a further supply of electricity in Hornsey.

Mr. Norman Staniland (borough electrical engineer), describing the proposed extensions, said the number of consumers in Hornsey was increasing monthly at a much more rapid rate than before the war. Hornsey had entered into a working agreement, for a minimum of ten years, with Finchley—and the necessary cables had been laid—really at the request of the Electricit; Commissioners.

Cross-examined by Mr. Henderson, the witness replied that it would not be economical, in any case, to take a supply from the North Metropolitan Power Co. and to shut up the Hornsey station altogether. At present they exchanged the same amount of electricity with Finchley, and if Hornsey took the Power Co.'s supply and passed it on to Finchley to carry out its agreement, then Hornsey would suffer because of the difference in price.

Mr. R. M. Montgomery explained, on the resumption of the inquiry on Tuesday, that the Corporation proposed to install similar plant to that used by the company, and there was no reason why it should not reach the same coal rate per kWh (2.2 lb.) as the company.

The inquiry was then closed; the Commissioners will give their decision in due course.

Local Electrical Societies.—The Glasgow Corporation Electricity Department Engineering Society commenced its session on October 1st, when Mr. R. B. Mitchell, president of the Society and engineer and manager of the department, delivered his annual address; Mr. H. M. Stronach presided. Mr. Mitchell reviewed the progress of the Department from the outbreak of war until the present year and gave some interesting figures to show the influence of certain events on the output and load of the undertaking. He also spoke of the operation of the Dalmarnock plant, and outlined the scheme for the further extensions which are about to be proceeded with.

At the opening meeting of the Edinburgh Electrical Society, on October 5th, Mr. D. C. Redfern read a paper on "Overhead Transmission." After dealing with the lay-out of various undertakings, Mr. Redfern gave some interesting financial statistics and recounted several types of faults which had occurred under varying conditions during his experience, describing various methods of counteracting such faults. Mr. J. Walker occupied the chair.

The first meeting of the Electrical Society of Glasgow for the current session was held on October 2nd, Mr. G. Morgan (chairman) presiding. There was a large attendance of members, and there was an open discussion on "The Wiring of Tenement Property," and various suggestions were submitted. Only 14,000 out of about 250,000 houses in Glasgow have electricity installed. It will be seen that there is a wide scope for development in this direction. At the close of the meeting the chairman intimated that Mr. R. B. Mitchell, City electrical engineer, was arranging to meet representatives of the property owners and house factors to discuss the matter.

The Manchester Wireless Society has arranged an attractive syllabus of popular and advanced lectures for the winter session. The first meeting took place on the 8th inst., when Mr. F. Charnley lectured on "Distortion and its Elimination." The 10-watt transmitting set (2 F2) is at

the disposal of members on each Saturday and Sunday afternoon, while the 1,000-watt transmitter (5 MT) will be worked each week from 11 p.m. on Saturday to 5 a.m. on Sunday.

Appointments Vacant.—Electrician for the Salford Corporation Sewage Works. Manager (£800 minimum) to arrange and supervise erection, staff, and operation of a combined display on behalf of the Electricity Supply Undertakings at the British Empire Exhibition, 1924. Shift engineer, switchboard attendant for the Rawtenstall Corporation Tramways and Electricity Departments. Engineer-in-Charge for the St. Monica Home of Rest, Bristol. Assistant electrical engineer (Rs. 825 per mensem) for the Madras & Southern Mahratta Railway Co., Ltd. (See our advertisement pages).

New Kinema Regulations.—New regulations, dated July 30th, 1923, by the Home Secretary under the Cinematograph Act, 1909, were issued last week (H.M. Stationery Office, price 4d. net). They are the outcome of discussions extending over some 18 months, and include important rules relating over some 18 months, and include important rules relat- auditorum and exits. The Wiring Rules of the Institution of Electrical Engineers are followed in the main. The projector circuit has to be separate from the general lighting circuit. The wiring is to be protected with metal conduit or wood casing; all fuses and distribution boards are to be of a completely protected type, and portable lamps are to be connected to separate circuits (these clauses do not apply to existing installations). Special regulations for the wiring in the projector enclosure are laid down for new installations, which are to be carried out with heavy-gauge screwed conduit, exposed cables being covered with asbestos. Live parts of apparatus near the projector are to be shielded, and except in the case of change-over switches, the switch handle must not work through an open slot. The potential difference between any two conductors inside the enclosure must not exceed 250 volts d.c. or 125 volts a.c. Metal work is to be earthed, and various precautions against touching live metal are prescribed. Special rules deal with the construction and situation of resistances and motor-generators or generating plant. Some of these requirements do not apply to existing installations; others must be complied with within two years from the date of the report. Portable projectors are dealt with in Part II, and are the subject of different regulations, one prescribing the use of "electric light in hermetically-sealed lamps" as the sole illuminant within the projector.

Contractors and others concerned in the use of electricity in kinema exhibitions will find it necessary to study these regulations very carefully; they are in some respects very stringent, but in our opinion not a whit too much so, and appear to have been well thought out.

Physics in Industry.—The fifth of the series of public lectures on this subject being given under the auspices of the Institute of Physics will deal with "Physics in the Textile Industries"; it will be delivered by Dr. A. E. Oxley, Physicist to the British Cotton Industries Research Association, at the Institution of Electrical Engineers, Victoria Embankment, London, on Monday, October 22nd, at 5.30 p.m. The chair will be taken by Sir Charles Parsons, K.C.B., F.R.S., who has just succeeded Sir J. J. Thomson as President of the Institute.

Electricians' Strike.—The National Federated Electrical Association informs us that an unauthorised strike by the employés of Messrs. Mann, Egerton & Co., Ltd., who are working on the contract for the electrical re-conditioning of the Government offices in Whitehall, has taken place. The men have been instructed to return to work by their Union, but have refused to obey this instruction. Under the working rules, as agreed with the Union, should any dispute arise, no stoppage of work should take place until the dispute has been referred to a joint committee for investigation. Should employers of electrical labour require any additional men they should communicate with Mr. L. G. Tate, general secretary of the N.F.E.A., before engaging them.

Dental Congress and Exhibition.—The International Dental Exhibition and the Annual Congress of the Incorporated Dental Society were held this week at the Imperial Institute, South Kensington. Both are of a professional character, but the Congress took the novel step of arranging two free lectures for the education of the public. The exhibition provided evidence of an increasing disposition to utilise X-rays for dental purposes—a resource hitherto more appreciated in the United States than in this country. When it is realised that only one-third of the length of a tooth can be inspected by ordinary means, the rest being covered by tissue, the importance of some satisfactory means of ascertaining the state of the covered part becomes obvious. Another improvement illustrated in the exhibition was the production of an electric drill free from vibration. In some fixtures and equipment porcelain is beginning to displace metal as being more easily kept clean. The exhibition was a good deal larger than last year's, and included exhibits from the United States, France, Belgium, and other countries.—*The Times.*

Conductors for Overhead Transmission Lines.—The British Engineering Standards Association is drafting standard specifications for conductors for use on overhead transmission lines. It is desired to specify the ultimate strength and the extension of single wires and stranded cables, and also the limit of proportionality and the modulus of elasticity. The Electrical Research Association, at the request of the Standards Association, has undertaken an investigation on hard-drawn copper, steel, and aluminium wires and cables to ascertain their physical properties. The tests have been carried out at the National Physical Laboratory. The results are of considerable practical importance, many of the tests having been carried out for the first time on 100-yard lengths of cable under conditions approximating to those of actual use, a high degree of accuracy being obtained throughout. The results are outlined in a series of reports from the B.E.A.I.R.A., published in the September issue of the I.E.E. *Journal*.

The first report (Ref. F/T5) deals with the results obtained with hard-drawn copper wires and cables, both short and long lengths. The physical properties and tests to which special attention was directed were as follows:—Ultimate tensile strength; extension on fracture; limit of proportionality; modulus of elasticity; and twist and warp tests.

The second report (Ref. F/T6) deals with the results of tests of hard-drawn aluminium wires and cables, both short and long lengths.

The third report (Ref. F/T7) deals with galvanised steel wires and cables, and the fourth (Ref. F/T13) with steel-cored aluminium cables. The conclusions arrived at in the latter case are that this type of cable behaves similarly to a homogeneous copper or aluminium cable, its tensile strength closely approaching the sum of the breaking strengths of the constituent wires, and its limit of proportionality increasing with repeated increasing loads. The limit of proportionality may be safely raised by this means to at least 60 per cent. of the breaking load of the cable.

With a seven-wire strand the breaking strength may safely be taken as 93 per cent. of the sum of the strengths of all the wires. A more general rule which it is suggested may apply to steel-cored aluminium cables having more than seven wires, is to assume that the breaking strength is .98 per cent. of the sum of the breaking loads of the aluminium wires, plus 89 per cent. of the sum of the breaking loads of the steel wires.

For the purpose of overhead-line calculations the modulus of elasticity may be computed on the assumption that the stresses in the two materials will be proportional to their moduli of elasticity. The value of the modulus of elasticity of the aluminium wires is consistent with the values obtained from tests on single wires of other diameters.

INSTITUTION NOTES.

Institution of Electrical Engineers.—East Midland Sub-Centre.—The first meeting of this Sub-Centre for the session takes place on Tuesday next at Loughborough College at 6.45 p.m., when the Chairman, Mr. E. G. Phillips, will read a paper on the "Pneumatic Handling of Coal and Heavy Materials." Other fixtures are as follow:—

October 30th (at Derby Technical College).—"Economical Generation of Electric Power in Small or Medium Sized Stations," by Mr. S. J. R. Allwood.
November 20th (Loughborough).—"Electric Control," by Dr. C. C. Garrard.
December 11th (Loughborough).—Address by Mr. J. D. Morgan.
January 8th (Loughborough).—"Telephone Inter-communication," by Mr. A. Brooks.
January 29th (Loughborough).—"Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.
February 19th (Derby).—"Recent Developments in Radio Communication," by Mr. H. V. Field.
March 11th (Nottingham).—"Some Notes on the Distribution of Electrical Energy," by Mr. A. D. Phillips.
April 1st (Leicester).—"Steam Evaporators and their Application," by Messrs. J. B. Maclean and E. G. Boissier.
April 29th (Loughborough).—"Special Dynamo-electric Machines for Wireless and Allied Applications," by Mr. F. Newton.

Meeting Hour.—The recent postcard vote taken among the members having addresses in the London district shows that the majority of those who voted were in favour of 6 p.m. for the ordinary meetings of the Institution, and it has accordingly been decided to continue to meet at 6 p.m. (Light refreshments at 5.30 p.m.)

North-Western Centre.—This Centre will hold its opening meeting on November 6th, when the Chairman (Mr. Jubilin) will deliver his address at the Midland Hotel, a smoking concert following. Other arrangements are:—

November 20th.—"The Drive of Power Station Auxiliaries," by Messrs. L. Breach and H. Midgley (subject to confirmation).
December 4th.—Informal meeting.
December 18th.—"Pulverised Fuel and Economical Steam Generation," by Mr. David Brownlie.

North Midland Centre.—The meeting arrangements of this Centre, not including those of the Sheffield Sub-Centre, for the session are as under:—

November 13th.—Opening meeting, Chairman's address and smoking concert.
November 27th.—"Technical Research, with Special Reference to Electrical Engineering Development," by W. Wilson.
November 4th.—Informal discussion, British Electrical Development Association: "Domestic Electrical Apparatus."
January 8th.—President's meeting.
January 22nd.—Lecture on "American and Continental Railway Electrification Developments," by Dr. S. P. Smith.
February 5th.—"Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.
February 26th, March 18th and 25th.—Subjects to be decided later.
April 8th.—Annual general meeting and smoking concert.

Dundee District Sub-Centre.—The meetings of this Sub-Section are to be held in the Engineering Class Room of the University College, Dundee, on the second Thursday in each month. The opening meeting took place yesterday, October 11th, with the reading of a paper on "Units" by Mr. J. C. Christie, the chairman.

Scottish Centre.—The programme of this Centre, as arranged so far, is as follows:—

November 13th (Glasgow).—Inaugural address by Mr. R. B. Mitchell, chairman.
December 11th (Glasgow).—"Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.
December 18th (Glasgow).—Dinner.
January 8th (Edinburgh).
February 12th (Glasgow).—Lecture on "American and Continental Railway Electrification Developments," by Prof. S. Parker Smith.
March 11th (Edinburgh).
April 8th (Glasgow).—Annual general meeting.
April 25th (Dundee).

In addition there will be one or two informal meetings in Edinburgh and a smoking concert at Glasgow in Februray.

Mersey and North Wales (Liverpool) Centre.—This Centre opens on November 5th with an address by Mr. E. M. Hollingsworth, the chairman. Other arrangements settled down to date are:—

November 19th.—"Industrial Research," by Mr. W. Wilson.
January 14th.—Popular lecture, "Radio-Reception," by Prof. E. W. Marchant, D.Sc.
January 25th.—Annual dinner.
April 28th.—Annual general meeting and informal discussion on "Domestic Electrical Appliances," by Mr. J. W. Beauchamp.

Irish Centre.—The programme for the session is as under:—

October 25th.—Opening address by Mr. R. N. Tweedy (chairman).
November 15th.—Lecture on "Modern X-ray Equipment and Practice," by Mr. P. G. Griffiths.
December 13th.—"Some Notes on a High-power Wireless Station," by Mr. T. J. Monaghan.
January 17th.—"Oil Engines," by Mr. Charles Day, M.Sc.
February 14th.—"Printing Press Equipment," by Mr. A. G. Bruty.
March 13th.—"Small Power Supply Schemes," by Mr. J. A. Kenny.
April 10th.—Subject later.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. J. Cathcart Christie, the chairman of the Dundee Sub-Centre of the Institution of Electrical Engineers, which held its opening meeting last night, is engineer and manager of the Arbroath Electric Light & Power Co., Ltd. He served his engineering apprenticeship in Glasgow in the works of Sir Wm. Arrol & Co., Ltd., and was afterwards employed for some years in the Woolwich works of Messrs. Siemens Bros. and Co., Ltd., from which he went to the Glasgow Corporation Electricity Department, where he was chiefly employed at the St. Andrews Cross and Port Dundas power stations. From Glasgow Mr. Christie went to Arbroath, where he supervised the erection of the new power station, and started up, and has since managed, the electricity supply in that town.

The Dundee Sub-Centre of the I.E.E. is one of the youngest branches of the Institution, but it is already becoming the centre of interest for electrical men in its own district. The interest taken in the Dundee Centre is shown by the fact that the members there have already filled up nearly all the dates in their syllabus for the coming session, and very little help will be needed in the way of papers lent for discussion from headquarters.

Mr. S. W. B. McGregor, H.M. Senior Trade Commissioner in Australia, accompanied by his wife, has arrived in London and is staying at the Hotel Victoria.

Captain R. C. Petter and Mr. R. J. Norton have been elected additional directors of Petters, Ltd.

Mr. Robert Edward Shott has been appointed secretary to the Victoria Falls & Transvaal Power Co., Ltd., in succession to the late Mr. Alfred Wilson Bird.

Belfast Corporation has increased the salary of Mr. Johnstone Wright, the city electrical engineer and manager, from £1,400 to £1,750 per annum.

Fulham Borough Council Electricity and Lighting Committee recommends that Mr. A. J. Maslen be appointed mains assistant, to fill the vacancy caused by the resignation of Mr. T. A. Taylor, at a salary of £266, in accordance with Grade 8B of the E.P.E.A. Schedule.

At the meeting of the Belfast Corporation on the 1st inst., the appointment of Mr. Samuel Carlile to be tramway manager in succession to Mr. J. S. D. Moffett, appointed to the Salford Corporation as manager of the tramway system there, came up for confirmation. There was considerable opposition to the confirmation of the appointment, an amendment to refer the matter back to the Tramway Committee having been proposed and well supported. On a vote being taken the appointment was confirmed by a substantial majority. Before leaving Belfast Mr. Moffett was the recipient of a presentation from the tramway staff and employés. Mr. Moffett made the journey from Belfast to Manchester by aeroplane, so that he literally "flew from Belfast."

It is announced in *Current Opinion* that the Rt. Hon. G. H. Roberts, M.P., has resigned his position as Joint President of the Industrial League and Council. The selection of his successor, to act with Lord Burnham, will come up at the annual meeting of the League in November.

In connection with the reorganisation of the staff of the Southern Railway, Mr. Herbert W. Jones, M.I.E.E., has been appointed electrical engineer and Mr. H. W. H. Richards, M.I.E.E., assistant electrical engineer.—*Faraday House Journal.*

Mr. Edward Cross.—The chairman of the Sheffield Sub-Centre of the Institution of Electrical Engineers for the 1923-24 session is Mr. Edward Cross, engineer and general manager of the Rotherham Corporation Electricity Supply Department. He will deliver his address on Wednesday next.

Mr. Cross, whose portrait accompanies this note, commenced his lighting and power supply experience with the National Electric Supply Co. at Preston. He later went to the Bradford Corporation undertaking, where he stayed for about four years. Mr. Cross's next position was that of chief assistant to the city electrical engineer of Aberdeen, and he relinquished this post in 1901 to take charge of the Rotherham undertaking. Mr. Cross facetiously attributes the financial success of the Rotherham undertaking to the careful habits acquired by him during his stay in Aberdeen. Under his direction the Rotherham system has developed in an almost phenomenal manner. In 1914 the capacity of the plant was only 4,500 kW; now with the new station, which was opened in May by the Prince of Wales, and described in our issue of June 1st (p. 862), the undertaking develops a total of 70,500 kW, representing a trifle over 1 kW per head of the town's population. The undertaking had a bad time during the "slump" period which followed the Armistice and accumulated a large deficit. In the last financial year, however, a net profit of over £38,000 was earned, and the outstanding loss now amounts to only £7,000. This large profit was made on a very low average price per kWh sold—1.265d.; it is noteworthy that the sale of energy in 1922-23 (39,613,426 kWh) was more than double that of the previous year.

Photo by] [*Lafayette, Ltd.*

Mr. Edward Cross, A.M.I.E.E., A.M.I.Mech.E.,
Chairman of the Sheffield Sub-Centre of the Institution of Electrical Engineers.

Obituary.—Mr. A. W. Heaviside.—Mr. Arthur West Heaviside, to whose death a brief reference was made in our last issue, retired nineteen years ago from the position of Superintending Engineer to the Post Office, having reached the age limit. In the previous year he had been invested by King Edward with the Companionship of the Imperial Service Order. Mr. Heaviside was born in London in 1844, and in his early career was engaged under Sir Charles Wheatstone. At the age of seventeeen he became assistant engineer to Sir Charles, of the Universal Private Telegraph Co., and a

few years later took up more responsible duties in charge of that company at Newcastle. At about this time he invented the A.B.C. private telegraph exchange system. When the telegraphs were transferred to the State in 1870 he went over to the Post Office and amalgamated the systems of which the State assumed ownership. *Who's Who* describes Mr. Heaviside as the inventor of the Bridge system of telephony and an original investigator of wireless telegraphy. His wireless experiments date back to 1881, and they continued for a good many years. Later—about 1887—electric lighting and power were being developed, and they claimed his attention. Mr. Heaviside was the first chairman of the Newcastle Section of the Institution of Electrical Engineers, for the period 1899-1901.

Mr. A. McIntosh.—The death took place on September 27th, at the age of 49 years, of Mr. Alexander McIntosh, A.M.I.E.E., superintendent of the mains and meters department of the Woking Electric Supply Co. He had been on the staff of the company for 23 years.

Mr. William Thomson, F.R.S.E.—We regret to record the death, which occurred suddenly in his laboratory on October 4th, of Mr. William Thomson, F.R.S.E., F.I.C., the well-known consulting chemist and analyst. He was 72 years of age. The *Manchester Guardian*, in referring to his career, says that in November, 1922, he presented to the Literary and Philosophical Society the actual tubes containing sulphides of calcium, barium, &c., which he demonstrated to Sir William Crookes in 1877, and which proved to be the first of three steps which led to the discovery of "X-rays" by Professor Röntgen. In recognition of his contributions to science he was elected a Fellow of the Royal Society of Edinburgh, and he was one of the original members of the Society of Chemical Industry.

Mr. J. Batty.—The death took place, on October 4th, at his residence at Nelson, of Mr. James Batty, aged 46, who had been in business in Burnley as an electrical engineer for 25 years, and was working up to a fortnight ago.

M. J. Violle.—On September 12th M. Jules Violle, member of the Institute of France, and inventor of the Violle standard of luminous intensity based on the use of platinum at its melting point, died suddenly at the age of 81 years.

Mr. W. G. F. Webster.—The death took place, on September 29th, of Mr. Walter George Frederick Webster, head of the firm of Webster & Son, electrical engineers, Dover Road, Folkestone. He was 68 years of age.

Dr. J. A. Harker.—We regret to learn, just as we go to press, that Dr. John Allen Harker, F.R.S., O.B.E., passed away at Highgate on Wednesday. He had been ill only a short time, and was 53 years of age.

Will.—The late Mr. E. J. Preston (a director of J. Stone and Co., Ltd., of Deptford) left £231,273 gross and £212,714 net personalty.

NEW COMPANIES REGISTERED.

Hestavox, Ltd. (192,879).—Private company. Registered October 4th. Capital, £5,000 in £1 shares. To take over the business of electrical engineers carried on by A. H. Rice and H. A. Rice at 32, Palmerston Road, Acton, W., as the Hesta Engineering Co., and to carry on this and the business of manufacturers of, and dealers in, and agents for instruments, apparatus, accessories and materials used in connection with radio or wireless or other telegraphy and telephony, &c. The permanent directors are:—C. C. Parker, 13, Hardwick Road, Chiswick, W.; S. K. Fey, 44, Birkbeck Avenue, Acton, W.3; A. H. Rice, 28, Gunnersbury Lane, Acton, W.3; H. A. Rice, 28, Gunnersbury Lane, Acton, W.3. Qualification, £1. Registered office: 32, Palmerston Road, Acton, W.3.

Midland Valves, Ltd. (192,850).—Private company. Registered October 3rd. Capital, £500 in £1 shares. To carry on the business of manufacturers of, and dealers in wireless telegraphy and telephony instruments, thermionic valves, electric light bulbs, wireless apparatus, &c. The subscribers (each with one share) are:—E. H. Walls, 712, Bordesley Green, Birmingham, solicitor's clerk; G. M. Butts, 84, Reynolds Street, Smethwick, solicitor's clerk. The subscribers are to appoint the first director. Qualification, 100 shares. Solicitors: Forsyth, Bettinson & Co., 36, Cannon Street, Birmingham.

H. H. Hornsey, Ltd. (192,873).—Private company. Registered October 4th. Capital, £1,000 in £1 shares. To adopt an agreement with H. H. Hornsey for the acquisition of the business of an electrical engineer and contractor, carried on by him at Cross Turner Street, Sheffield. The subscribers (each with one share) are:—H. H. Hornsey, 8, Woodland View, Dore, near Sheffield, electrical engineer; L. R. Gillman, 61, Tillotson Road, Heeley, near Sheffield, acetylene welder. H. H. Hornsey signs as director. Qualification, £25. Registered office: Electra Welding Works, Cross Turner Street, Sheffield.

Bagenalstown Electric Lighting and Power Co., Ltd.—Private company. Registered in Dublin October 2nd. Capital, £4,000 in £1 shares. To install electric lighting and power in Bagenalstown. The first directors are:—Rev. Matthew Cullen, P.P., Bagenalstown, Co. Carlow; G. Brown, Donald, Bagenalstown, general merchant; M. Sheill, Bagenalstown, licensed merchant; C. Cleary, Church Street, Bagenalstown; T. P. Phelan, Bagenalstown, auctioneer. Secretary: J. Foley. Registered office: Church Street, Bagenalstown, Co. Carlow.

Westminster Radiophone Co., Ltd. (192,793).—Private company. Registered October 1st. Capital, £5,000 in 4,750 shares of £1 and 5,000 shares of 1s. To carry on the business indicated by the title. The permanent directors are:—F. Whatton, 113, Akerman Road, Brixton, S.W., civil engineer; E. M. Burrows, 284, Broadway, Bexley Heath, S.E., merchant. Registered office: 110, Victoria Street, Westminster.

Nefa Co., Ltd. (192,813).—Private company. Registered October 1st. Capital, £1,000 in £1 shares. To carry on the business of wholesale and retail dealers in, and manufacturers of electrical appliances of all kinds, electricians, mechanical engineers, manufacturers of and dealers in domestic appliances, telephones and all apparatus for the generation, accumulation or distribution of electricity; advertising agents and contractors, dealers in, and manufacturers of fancy goods, silver and electro plate, leather and textile goods; general carriers, forwarding agents, and haulage contractors, &c. The first directors are:—S. Culverwell, 27, Queen Victoria Street, E.C.4, chartered secretary; H. V. Molback, 25, Church Street, W.8, merchant; H. Sanders, 164, Ebury Street, S.W.1, merchant (all permanent, subject to holding 200 shares each). Registered office: 27, Queen Victoria Street, E.C.4.

Bennett & Methven, Ltd. (192,823).—Private company. Registered October 2nd. Capital, £1,000 in £1 shares. To take over the business of motor accessory dealers, wireless and component part manufacturers, &c., carried on by T. W. Bennett and C. E. Methven at Grove Hill Road, Denmark Park, S.E.5. The first directors are:—T. W. Bennett, 83, Grove Hill Road, Denmark Park, S.E.5, engineer (managing director); C. E. Methven, 1, Lancroft Road, East Dulwich, S.E.22, electrical engineer. Registered office: 83, Grove Hill Road, Denmark Park, S.E.5.

Skipton Electrical Co., Ltd. (192,832).—Private company. Registered October 2nd. Capital, £1,000 in £1 shares. To acquire the business of electrical engineers now carried on by F. G. Robson, B. Birtwhistle, and P. Vickerman at Waller Hill, Skipton, Yorks., as the "Skipton Electrical Co." The subscribers (each with one share) are:—A. Roberts, "Cragg Cottage," Rawdon, near Leeds, electrical engineer (director of Roberts Bros., Engineers, Ltd.); P. Vickerman, 81, Main Street, Cononley, Yorks., electrical engineer; F. G. Robson, 85, Main Street, Cononley, Yorks., electrical engineer; B. Birtwhistle, 14, Gladstone Street, Skipton, electrical engineer. A. Roberts is the first and permanent governing director. Solicitors: T. H. Thacker, Argus Chambers, Leeds Road, Bradford.

A. F. A. Accumulators, Ltd. (192,794).—Private company. Registered October 1st. Capital, £5,000 in £1 shares. To acquire the business of an engineer now carried on by Emile G. Lind at 58a, Buckingham Palace Road, S.W., as "E. G. Lind & Co.," and to carry on the business of makers of electrical accumulators and primary and secondary cells, &c. The first directors are:—E. G. Lind, "Heathlands," Chadwell Heath, Essex; A. W. Fithian, 51, St. James' Road, S.W.17; Fredk. Weissleder, Askanischer Platz 3, Berlin, S.W.11. So long as the Accumulatoren-Fabrik Aktiengesellschaft holds not less than 1,000 shares, it may be represented on the directorate by a nominee to be appointed from time to time. Secretary: W. A. Green. Registered office: 58a, Buckingham Palace Road, Westminster, S.W.1.

Thompson & Howells (Bristol), Ltd. (192,856).—Private company. Registered October 3rd. Capital, £1,000 in £1 shares. To acquire the whole or any part of the right, title, and interest in or appertaining to the application by H. W. Thompson, numbered 17,804, and dated July 10th, 1923, for the grant of British letters patent in respect of an invention relating to telephone receiver holders, and to carry on the business of manufacurers of, agents for, or dealers in telephone receiver holders, &c. The first directors are:—J. Thornber-Howells, "The Pantiles," Brean Down Avenue, Weston-super-Mare; H. W. Thompson, 43, Severn Avenue, Weston-super-Mare. Secretary: H. W. Thompson. Registered office: 127, Victoria Street, Bristol.

Woodhall & Partners, Ltd. (192,918).—Private company. Registered October 5th. Capital, £5,000 in £1 shares. To acquire the business of electrical and mechanical engineers now carried on by the Engineering Equipment Co. (1919), Ltd., at Coleridge House, Mount Street, Swansea, and to carry on the business of contractors for cold-storage insulation, including the covering of brine and ammonia pipes, contractors for soundproofing and fireproofing buildings, &c. The first directors are:—E. H. Woodhall, Coleridge House, Mount Street, Swansea; C. H. Brazel, "St. Sixte," Haslemere Road, Sketty, Swansea. Qualification, £250. Secretary: E. H. Woodhall. Registered office: Coleridge House, Mount Street, Swansea.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

South London Electric Supply Corporation, Ltd. (50,392c).—Return dated April 5th, 1923. Capital at date of return, £310,000 in 10,000 6 per cent. preference shares of £5 each and 65,000 ordinary shares of £4 each. 6,000 preference and 65,000 ordinary shares taken up. £290,000 paid. Mortgages and charges, £130,000.

Resolution passed March 22, and confirmed April 12th, 1923:—That each of the existing 65,000 ordinary shares of £4 each be divided into four shares of £1 each, and each of the existing 10,000 preference shares of £5 into five shares of £1 each.

Mica and Asbestos Insulating Co., Ltd.—Debenture, dated September 24th, 1923, to secure £750, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Electro-Werke Isola Société Anonyme, Oerlikon, Zurich.

J. W. Barnard & Haynes, Ltd.—Particulars filed of £500 debentures authorised August 11th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £300.

Wainwright Manufacturing Co., Ltd.—Issue on September 11th, 1923, of £200 debentures, part of a series already registered.

Radio Stocks, Ltd.—Second debenture dated September 24th, 1923, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. C. Herritage, 200, Sutherland Avenue, Maida Vale, W.

Premier Electrical Engineering Co., Ltd. (in liquidation).—Satisfaction in full on September 21st of debenture dated August 13th, 1923, securing £200.

Electric and Ordnance Accessories Co., Ltd.—Satisfaction in full on August 31st, 1923, of debentures dated January 12th, 1903, securing £130,000.

Marconi International Marine Communication Co., Ltd. (65,759).—Return dated July 27th, 1923. Capital, £1,500,000 in £1 shares. 1,192,726 shares taken up. £1,087,726 paid. £105,000 considered as paid. Mortgages and charges, £57,320.

Edmundson's Electricity Corporation, Ltd. (52,013).—Return dated July 25th, 1923. Capital, £640,000 in 80,000 ordinary shares of £3 each and 40,000 cumulative preference and 40,000 non-cumulative preference shares of £5 each. All shares taken up. £600,400 paid on 66,800 ordinary, 40,000 cumulative preference, and 40,000 non-cumulative preference shares. £39,600 considered as paid on 13,200 ordinary shares. Mortgages and charges, £342,828.

Chili Telephone Co., Ltd. (29,252).—Return dated August 8th, 1923. Capital, £500,000 in £5 shares. 99,000 shares taken up. £275,000 paid. £220,000 considered as paid. Mortgages and charges, nil.

George H. Neal & Co., Ltd.—F. Wilcock, of 1, Great Winchester Street, E.C., was appointed receiver on September 28th, 1923, under powers contained in debentures dated February 22nd, 1923.

Lisbon Electric Tramways, Ltd. (62,983).—Return dated July 11th, 1923. Capital, £1,250,000 in £1 shares (750,000 ordinary and 500,000 preference). 634,026 ordinary and 425,553 preference shares taken up. £134,026 paid on 134,026 ordinary. £925,553 considered as paid on 500,000 ordinary and 425,553 preference. Mortgages and charges, £466,300.

Hightensite and Ebonite Manufacturing Co., Ltd.—Particulars filed of £10,000 debentures, authorised September 24th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Three-Star Accumulators, Ltd.—Mortgage on certain freehold premises at Rosebery Avenue, Tottenham, dated September 14th, 1923, to secure all moneys due or to become due from company to the L.J.C. and Midland Bank.

CITY NOTES.

Siemens Bros. and Co., Ltd.

With reference to the statements that were in circulation in the Press a few weeks ago regarding the affairs of this company, which statements were briefly summarised in the Electrical Review for September 28th, p. 474, we are now able to publish a circular letter issued under date October 4th by the secretary of the company:—"The company has received communications from several shareholders referring to a circular dated September 19th, 1923, issued by the New Trust, Ltd. I am instructed by the Board to inform you that the company has no knowledge of the New Trust, Ltd., nor does the name appear on its share register. I am also to inform you that the business is steadily recovering from the general industrial depression, and that the improvement mentioned by the chairman at the general meeting in May last has since been well maintained.—W. Wheeler, *Secretary*."

Ferranti, Ltd.

The directors' report, which is to be presented at the annual meeting on October 18th, states that the net profit for the year is £36,362, after making provision for general establishment charges, bad debts, repairs and renewals, taxation, interest on debenture stock and notes, and making the usual allocation to depreciation reserve. The balance at the credit of profit and loss account at the end of the 1922 period was £40,494. From this is deducted five years' arrears of dividend on the 6 per cent. cumulative preference shares (£16,012), leaving a balance of £24,482 to be added to the year's profit. It is recommended that the total, £60,844, be allocated as follows: General reserve account, £20,162 (making £90,000); dividends on 6 per cent. cumulative preference and 7 per cent. preference shares, £9,520; dividend of 10 per cent., free of tax, on ordinary share capital, £6,000; leaving £25,162 to be carried forward. The scheme for the re-organisation of the company's capital has been carried out, and the results of the year's trading are reported to have been satisfactory.

Parsons' Marine Steam Turbine Co., Ltd.

The report for the year ended June, 1923, states that, owing to shipbuilding depression, the works have been only partly employed. Since the last report no orders have been secured for marine turbine installations, but further orders have been placed with the company by Messrs. C. A. Parsons & Co. for the manufacture of turbines, &c., for use in connection with land installations. Expenditure on experimental, pioneer and development work for the year amounted to £8,469. Profit, £22,073, plus £29,210 brought forward, making £51,284. The directors recommend a dividend of 10 per cent. for the year, free of tax, carrying forward £30,156.

Prospectus.

The East African Power & Lighting Co., Ltd.—The list opened on Tuesday and was to close on or before to-day, Friday, in an issue of 200,000 ordinary shares of 20s. each offered at par. The company owns the Nairobi Electric Power & Lighting Co., Ltd., and the Mombasa Electric Light & Power Co., Ltd., and is the sole licensee in and around Nairobi and for the whole of the island of Mombasa. Mr. E. W. Monkhouse, the engineer to the company, in a report prepared after a recent visit, states: "The business of the company is increasing at both centres and the provision of extra plant at both centres is urgent, but at Mombasa particularly so, as in this place the existing plant is seriously overloaded. I have been intimately connected with the Kenya Colony (lately known as British East Africa) for many years, and I am glad to be able to report that, on this last visit, I have been struck with the progress made since my previous visit. There is a general demand for the supply of electric power for domestic purposes as well as for industrial enterprises of various kinds, and the prospects for wider developments are distinctly favourable." The proceeds of this issue will be applied in redeeming the whole of the outstanding debentures which have been offered to the company at the price of £126,000, and in payment for the buildings and additional plant contracted to be purchased.

The Swiss Bank for Electrical Undertakings.

As was mentioned a week ago, the directors of the Bank fur Eletrische Unternehmungen of Zurich have come forward with a new scheme of reconstruction. According to their report, a fresh reduction in the capital is to be made, which will not only extinguish the deficit of 51.21 millions of francs, but also permit of further provision for depreciation in order to meet any possible future losses on exchange and securities. It is proposed for this purpose to reduce the ordinary shares from 250 fr. to 50 fr. and the preference shares from 1,000 fr. to 500 fr., while the deferred shares will be converted into ordinary shares. This further curtailment of the capital will yield a reorganisation "profit" of 62,000,000 fr., which will permit of the wiping out of the deficit above mentioned, an allocation to the ordinary reserve fund, and provision for further depreciation.

German Companies.

The Insulating Tube Co., of Lintorf, has approved the payment of a dividend at the rate of 750 per cent. for 1922-23, this result being attributed to the investment of the amount intended for distribution in stable values at about the end of the financial year.

The Rheydt Cable Works Co., of Rheydt, does not propose to pay any dividend for the year 1922-23, in order not to diminish the working funds, the profits being carried forward. It is now intended to increase the ordinary share capital by 15 to 100 millions of marks.

The Electro-Works Co., of Berlin, which is now a State-owned undertaking, controlling large generating works in the Litterfeld lignite district, has declared a dividend at the rate of 200 per cent. on share capital of 600 millions of marks, this comparing with 8 per cent. in 1921-22.

The Korting's Electricity Works Co., of Berlin, has decided not to distribute any dividend on the ordinary shares for 1922-23 but to allocate 137 millions of marks to the works' maintenance fund. The net profits amounted to 12.19 millions, as against 2.4 millions in the previous year and a dividend at the rate of 7 per cent. has been declared on the preference shares.

Isle of Wight Electric Light and Power Co., Ltd.—Profit for 1922 £29,422, making available, after providing for interest, preference dividend, depreciation, &c., and including £583 brought forward, £11,005. Dividend 3 per cent., free of tax, on ordinary shares; £3,500 to reserve; £339 forward.—*Financial Times.*

Hurst Nelson & Co., Ltd.—Gross profit, £74,152; credit balance £62,228, plus £18,187 brought in. To general reserve, £10,000; dividend on ordinary shares of 2s. per share and bonus of 1s. per share, both free of tax; to reserve for payment of an interim dividend on ordinary shares next May, £10,000. Preference dividend requires £12,000, leaving £18,415 to be carried forward.

Western Electric Distributing Corporation, Ltd.—Final dividend at the rate of 10 per cent. per annum on the ordinary shares.

Traction and Power Securities Co., Ltd.—An interim dividend of 3s. 6d. per share, tax free, on the ordinary shares is announced.

Clayton & Shuttleworth, Ltd.—The accounts for the half year ended June do not justify payment of the preference dividend.

Yates & Thom, Ltd.—Dividend of 7½ per cent. actual on the ordinary shares; £10,000 to reserve, carrying forward £22,960.

Trafford Park Estates, Ltd.—Dividend at the rate of 6 per cent. per annum, carrying forward £96,134.

STOCKS AND SHARES.

Tuesday Evening.

Political affairs abroad, which are deemed responsible for the slowness of business in many of the markets round the Stock Exchange, exert little influence over the departments with which these notes deal. One of the features during the week has been a revival of interest in Metropolitans and Districts, both of which stocks spurted sharply as soon as the weaker bulls were cleared out after the last settlement. It is noteworthy that when the two stocks go ahead, the subsequent reaction which generally overtakes them seldom goes to the length of the stocks falling back to any appreciable extent. They gain ground with the certainty of a good Rugby three-quarter, and though the fluctuations are spasmodic and erratic, the result is always to leave the prices higher on balance.

The fluctuations bear out the course anticipated for these two stocks as indicated here from time to time. The railways are doing well, the prospects for next year's traffic with the Wembley Exhibition open are distinctly promising, and there is always the expectation, likely to be realised some day, that

the companies will be absorbed in one of the bigger groups and at satisfactory figures. Underground Electric shares of £10 each have again advanced, and the bonds are close upon par. At the close of business on Tuesday night, the shilling shares had risen to 10s. 3d. London Electric Railway shares at 7 are 5s. up.

Great interest is being taken in the considerations advanced here last week with regard to the possibility of the London electricity supply companies having their tenure of life extended for another 40 years from 1931, when the original concessions run out. For the moment much depends upon the line taken by the L.C.C., though, as previously reported, the prospects are that agreement will be reached by the County Council and the companies themselves that will enable the two groups to go before the Electricity Commission with a harmonious scheme. The interests of the consumer must be jealously guarded. In the front rank of the electricity supply industry are men gifted with sufficient vision to enable them to see that the interests of their undertakings are so closely identified with the supply of power at really cheap rates that those who are piloting the matter through its present stages can be trusted to put the consumer's advantage in the main part of their programme.

In consequence of the existing position, many inquiries are being made as to the best shares into which money can be invested at the present time. Candidly, it is difficult to choose between the best of the London companies' shares. Some people prefer those of the West-End companies; others think that there is greater scope with the shares of such concerns as the County of London, whose power business is practically unlimited. The South London has a contract with the Southern Railway, and although this is no doubt based on rates that are cut very fine, it enables the company to take on big work for other bodies as well as for private customers. Lists have been published here, during the past few weeks, showing what shares are obtainable in the market, and, although most of the prices show advances since these figures were tabulated, there is nothing in the present situation which suggests that prices have reached their apex, although the element of uncertainty which envelops the question of extension of tenure cannot be ignored by the careful investor.

Charing Cross ordinary are one of the firmest features in this market, the price showing a rise of another 10s. at £13. Metropolitans are better at 33s. 9d.; Urbans and Edmundsons have risen 1/16; Edmundson's preference at 5 have advanced to their par value. Bournemouth & Poole are changing hands fairly often on the basis of 37s. 3d. Midland Counties Electric ordinary are hard at 21s. 6d., and the 6 per cent. preference, upon which the next dividend in March, 1924, will be a broken amount, are worth the consideration of the investor at the present price of 20s. 3d.

Eastern Telegraph ordinary has recovered its dividend of 2½ points deducted last week, and the group as a whole is firm, it being once more easier to sell stock than it is to buy in this market. Marconis at 2 5/16 have recovered their slight loss of a week ago, and Marconi Marines are better at 28s. 3d. The Anglo-American stocks are steady.

British Electric Traction ordinary at 74½ is a point to the good, and the 6 per cent. preference stock has risen to 101½. Brazilian Tractions are a little better. Mexico Tramway 5 per cent. at 78½ put on 2 points since their last week's improvement, though the market for Mexican Utilities is still dormant. Tokio Electric sixes at 86½ have gone back 10s. Torquay Tramways shares put on 1/16 at 25s.

The allotment letters of Lancashire Electric ordinary and preference came out on Tuesday morning, and the prices of both are about 7½d. premium. The issue was considerably oversubscribed. The East African Light & Power prospectus made its appearance this week, the details following those which have already been given briefly here. There is a persistent demand for all the debenture and preference stocks amongst electricity supply companies. No small part of the stocks and shares which we have mentioned here in the various lists as being on offer during the past few weeks has been absorbed, and demand still clamours for more. Callender's first and "B" preference shares are up to 25s. and 26s. 3d. respectively, showing rises of 1s. 3d. British Insulated 6 per cent. preference are better at 23s. 9d. Victoria Falls preference improved to 28s., and the ordinary shares are a strong feature at 30s.

Siemens Brothers & Co. have issued a statement, rather tardily perhaps, in answer to the circular sent out some ten days ago by the New Trust. Siemens point out that the undertaking is steadily recovering from the general industrial depression, and that the improvement which, as the Chairman observed five months ago at the meeting, was then noticeable, has been maintained. On this, the price of the shares improved a trifle, the ordinary being quoted 14s., the preference 21s. 9d., and the 4½ per cent. debentures 77½, the last-named being a somewhat nominal market.

Electrical manufacturing shares as a whole are steady, with Edisons better at 5s. and Brush 26s. The ordinary shares in the cable manufacturing group are also firm at their previous prices. In the engineering list, Babcocks have moved up a trifle, though the improvement is not noticeable in the nominal official price. The rubber market remains dull, owing to the heaviness of the price of the raw material, and the lack of practical interest shown by the public.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Oct. 9, 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	2¾	—	£5 16 8
Charing Cross Ordinary	5	9	14	13	+ ½	5 7 8
do. do. do. 4½ Pref.	5	4½	4½	4¼	—	5 6 0
Chelsea	1	6	10	28/-	—	5 5 3
City of London	1	14	15	2½	—	5 19 1
do. do. 6 % Pref. ...	1	6	6	24/-	—	5 4 4
County of London	1	8	10	2⅝	—	4 15 6
do. do. 6 % Pref. ...	1	6	6	22/3	—	5 3 3
Edmundson's Ordinary	3	Nil	7	9⅜	+ ⅛	5 16 0
do. 6 % Pref	5	12/-	6	5	+ ⅛	6 0 0
Kensington Ordinary	5	10	12	9½	—	6 1 6
London Electric	3	4	10	4⅝	—	6 3 3
do. do. 6 % Pref. ...	5	6	6	5⅛	—	5 11 7
Metropolitan	1	7	8½	1 11/16	+ 1/16	5 0 7
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	16/3	−9d.	3 1 6
do. 5 % Pref. ...	1	5	5	15/9	—	6 7 0
do. 7 % Pref. ...	1	7	7	23/-	—	6 1 9
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	16/3	+ 1/16	Nil
do. 5 % Pref. ...	1	2½	5	3	—	6 17 0
James' and Pall Mall ...	5	12	14½	11⅞	—	6 3 5
South London	1	7	10	1 1/16	—	5 8 3
South Metropolitan Pref. ...	1	7	7	24/6	—	5 14 3
Westminster Ordinary	5	10	12	10½	—	5 17 1
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	1	—	7 10 0

Home Rails.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2¼	3½	77½	+1	4 10 6
do. District	,,	1	3	54½	+1	5 10
Underground Electric Ordinary	10	Nil	Nil	3⅜	+ ⅛	Nil
do. do. "A" ...	1	Nil	Nil	10/3	+9d.	Nil
do. do. Income	Bonds	4	5	99	—	*5 1 0

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	102½	—	5 17 1
do. Def.	,,	1½	34/6	23	—	6 9 0
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7½xd	—	9 13 2
Eastern Extension	10	10	10	17½xd	+ ⅛	5 14
Eastern Tel. Ord.	Stock	10	10	175½xd	+2½	5 14 0
Globe Tel. and T. Ord.	10	10	10	17⅜	+ ⅛	5 13 6
do. do. Pref.	10	6	6	11½	—	5 7 7
Great Northern Tel.	10	24	22	27½	—	8 0 0
Indo-European	25	10	7	9½	—	5 7 8
Marconi	1	25	15	2 7/16	+ 1/16	6 9 10
Oriental Telephone Ord. ...	1	12	12	1⅜	—	*6 8 9
United R. Plate Tel.	5	8	8	6⅝	—	*5 16 6
West India and Panama ...	10	Nil	Nil	1/6	—	Nil
Western Telegraph	10	10	10	17⅜	—	*5 15 0

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	2 1/16	—	9 7 2
do. do. 2nd Pref.	5	Nil	5½	2 3/16	—	11 17 10
do. do. 5% Deb.	Stock	5	5	75½	—	6 12 5
British Electric Traction Ord.	,,	4½	5	74½	+1	6 14 1
do. do. 6% Pref.	,,	6	6	101½	+1	5 18 3
Brazil Tractions	100	Nil	4	46½	+ ½	8 12 0
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	87½	—	5 14 3
do. do. Preferred	,,	5	20/-	86	—	*5 12 0
do. do. Deferred	,,	3	127/-	97½	—	*6 10 0
do. do. Deb. ...	,,	4½	4½	79½	—	5 7 0
Lond. & Sub. Trac. 5 % Pref.	1	3½	5	9/-	—	11 2 0
London United Tram. Deb. ...	Stock	4	4	60½	—	6 12 3
Mexico Trams. 5 % Bonds ...	—	Nil	Nil	78½	+2	6 10 9
do. 6 % Bonds ...	—	Nil	Nil	85½	—	Nil
Mexican Light Common ...	100	Nil	Nil	28	—	Nil
do. Pref.	100	Nil	Nil	55½	—	Nil
do. 1st Bonds ...	—	Nil	5	66½	—	7 10 3

Manufacturing Companies.

Babcock & Wilcox	1	15	20	21½	—	*4 9 1
British Aluminium Ord. ...	1	10	5	18/3xd	—	5 9 8
British Insulated Ord.	1	15	15	24	—	6 0 0
Callenders	1	15	15	23	—	6 6 4
do. 6% Pref.	1	6½	6½	25/-	+ 1/16	5 4 0
Crompton Ord.	1	10	5	7/16	—	9 17 6
Edison-Swan	1	10	Nil	5/-	+6d.	Nil
do. do. 5% Deb.	Stock	5	5	65	—	7 13 10
Electric Construction	1	10	10	11½	—	6 16 1
English Electric	1	8	5	17/3	—	5 16 0
do. do. Pref.	1	6	6	19/-	—	6 6 4
Gen. Elec. Pref.	1	6½	6½	23/-	—	5 13 3
do. Ord.	1	10	5	18/9	−6d.	5 6 8
Henley	1	15	15	23	+ 1/16	6 6 4
do. 4½ Pref.	5	4½	4½	4⅜	—	5 2 10
India-Rubber	1	10	—	10/-	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	1⅛	—	Nil
Telegraph Con.	12	20	20	25	—	*5 0 0

* Dividends paid free of Income Tax.

THE BRITISH ASSOCIATION—V.

A Method of Improving the Voltage Wave-Shape of an Alternator by External Circuits.

By Prof. E. W. Marchant, D.Sc., and T. H. Turney, B.Eng.

(Abstract of paper read before Section G—Engineering.)

The paper describes a method of securing an approximately true sine-wave alternating current from a machine not designed with this characteristic. The principle involved in the method is to short-circuit each phrase of the alternator for the frequency of the ripple which it is desired to eliminate by introducing a shunt which is in resonance with the frequency of the ripple, and to cut down the short-circuit current by introducing an additional inductance, which may be called the limiting inductance. With this arrangement the drop in pressure, due to the harmonic, is taken up in the limiting inductance, and the wave shape of pressure of each phase becomes correspondingly improved. Each shunt consists of a condenser in series with a choking coil, the values of capacity and inductance being so chosen that the shunt considered apart from the alternator is in electrical resonance with the frequency of the particular harmonic in the voltage wave which it is desired to eliminate. There is thus one distinct shunt for each harmonic dealt with. For best results the resistance of the shunt should be a minimum, and it is advantageous to have considerable impedance in the alternator, since this reduces the current passing through the shunt, and thus lowers the amplitude of the harmonic in the wave of terminal p.d.

The inductance coil must be so designed as to have the greatest inductance with the smallest possible resistance. This result can only be achieved by using a coil having a very large section of copper, and the extent to which the harmonic of

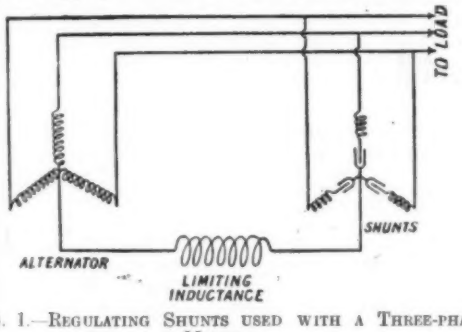

Fig. 1.—Regulating Shunts used with a Three-phase Machine.

e.m.f. is eliminated depends almost entirely on the weight of copper that is used in the shunt coils. Currents may flow in one shunt due to a harmonic which is dealt with by another shunt, but these currents will be negligibly small for two reasons. First, when all the shunts are in, the amplitude of the harmonics is greatly reduced; and secondly, the impedance of the shunt to any harmonic other than the one it is designed to eliminate is very great. For a given inductance a better correction is obtained for the higher harmonics. The correction may be further improved by placing an additional inductance in the circuits; this tends to decrease the currents flowing in the shunt, though it has the effect of making the regulation of the alternator for the main frequency worse. The shunts are placed between each phase and the neutral, there being three shunts for every harmonic dealt with (see fig. 1). The additional inductance is placed at the star point as shown and, therefore, the regulation between phases is not affected while the harmonic currents may be greatly reduced.

The paper gives particulars of the results obtained with certain machines under test, by the addition or subtraction of inductance to regulate the shunt currents until the true wave shape was formed.

When an alternator is loaded, the terminal voltage wave-form is generally different from the open-circuit voltage wave. This is due to distortion of the field produced by the armature ampere turns, and it is shown that if a machine on load develops a harmonic which is absent, or nearly so, at no load, the amplitude of the harmonic in question is proportional to the armature current at intermediate loads, and is not affected by a change in the field exciting current.

In general, the harmonics in the wave-form of a loaded alternator may be separated into two groups, first those which are produced directly by the field form and conductor grouping and which, therefore, occur at no load and do not alter with load; and, secondly, those which are due to distortion of the field by the armature currents, and whose values are proportional to the armature currents. If a machine has two opposing harmonics of the same order, one in each class, then it may happen that the resultant value of that harmonic may be a maximum at no load and a minimum or even zero at full load. In the case of the above machine the two harmonics are in phase and the value of the resultant harmonic grows as the load increases. This effect does not preclude the use of this method of improving the wave shape, for if a shunt is designed for the maximum value ever attained over the whole range of load for each harmonic in the voltage wave, that wave will be corrected successfully at all loads. As the load changes the currents in the shunt, of course, will change, but there will always be a constant fundamental frequency current from the alternator. From the above it follows that the maximum value of any harmonic is likely to occur either at no load or at full load, and it would be sufficient to take an oscillogram at no load and one at full load, analyse both, make a list of the harmonics in each, and design a shunt for each harmonic observed, bearing in mind that if the same order of harmonic occurs in both groups, it is sufficient to design a shunt for the one which has the greater amplitude.

In the design of each shunt the order of the harmonic will determine the value of the product of the capacity and inductance, and the amplitude of the harmonic will give the maximum current which will flow, and the inductance must be designed to carry this current. The ratio of the capacity to the inductance is determined by the fact that the current through the condenser must be such as not to produce higher voltage than its safe working pressure.

From the foregoing analysis of the method it will be seen that under normal circumstances the correction of a wave shape may be effected by the arrangement described above without altering the design of the alternator or decreasing its rating to any appreciable extent.

An appendix to the paper summarises the conditions of design which govern the terminal voltage wave shape of alternators.

Discussion.

Mr. W. M. Mordey considered that Prof. Marchant had rather under-estimated the importance of the suggestion he had made in his paper, and that it would be of very great value in practice. It would certainly simplify the question of design, because people would not have to pay so much attention of getting rid of the departures from the most desirable form of curve, and it might actually cheapen construction as a whole, because it would allow the defect to be remedied afterwards rather than in the actual design itself.

Prof. F. G. Baily also considered that Prof. Marchant had under-estimated the practical importance of his invention—for it was a definite invention—from the point of view of economy. On the other hand, he had rather over-estimated the improvement in alternators. Nowadays every alternator had a sine wave. Prof. Marchant had rather minimised the trouble which harmonics would produce. A little while ago he (Prof. Baily) had been running a rather sensitive parallel arrangement. Two parallel alternators producing varying harmonics would produce variegated waves running round the closed circuit. He was running an induction motor, and had put it on the oscillograph, because he had rather suspected that it would be sensitive to harmonics. The alternator was used on a fixed harmonic and the induction motor ran almost on a pure sine wave. The result was remarkable; it was exactly like a condenser of very low resistance. The harmonics were accentuated and the shape of the wave was almost unrecognisable. To fit Prof. Marchant's arrangement to any of these machines would be extremely useful; it was a cheap and easy way of filtering out the ripples, and it would have considerable application, both in laboratory and heavy work.

Prof. G. W. O. Howe said that this was a matter of considerable importance in connection with the electrification of railways, and in dealing with interference with telephone lines running along the railway tracks.

Dr. T. F. Wall asked whether Prof. Marchant proposed to use separate tuning circuits for each harmonic, and, if so, was there any information as to whether the cost would be prohibitive?

Prof. F. C. Lea suggested the application of Prof Marchant's method to Haigh's electromagnetic alternating stress testing machine, which gave a wave which was far from a sine wave. That difficulty might be minimised by means of this device.

Mr. H. Jack (British Thomson-Houston Co., Ltd.) said that his company had actually installed frequency filters. He believed there was one at Galashiels, one at Harrogate, and another on the South Coast. They had been very effective in eliminating harmonics, and seemed to be very similar to those described by Prof. Marchant. As a designer of machines he said that it was very much easier now to get pure sine waves, and one method adopted was to use a fractional number of slots per pole per phase in the alternator, *e.g.*, 3 1/7th.

Prof. Marchant, replying to the discussion, said he had not an estimate of the cost of installing the apparatus he had described, and therefore could not give any information with regard to the cheapness of the method, but, judging from the cost of the condensers to-day, he did not think it would be very heavy.

Individual Variations in Efficiency and the Analysis of the Work Curve.

By Dr. P. Sargant Florence.

(*Abstract of paper read before Section F—Economics.*)

This paper sums up the information supplied by the numerous work curves that have been presented of late years, both in England and America. The work curve is the expression used to describe the course of output traced throughout the day by hourly measurement. The theory is that as the working spell or day proceeds the fatiguing effect of continuous hours of work will make itself felt objectively in a definite fall of output. The chief practical value of the work curve is to discover the most productive distribution of working hours given duration. When, as at present, the total working hours and, within limits, their time of occurrence, are restricted by State legislation and agreements with trade unions, it becomes of the greatest interest to employers to know how best to group these hours into spells of continuous work with intervals for food and relaxation. An investigation carried out by the author, chiefly in an American metal factory working a ten-hour day, justifies the following conclusions:—

1. In spite of individual differences in the output of a group, working on and off for a given period at similar operations, the work curves that have been collected and averaged for whole groups are a typical representation of the resting and working habits of industrial employés. These show, briefly, that in the absence of deliberate restriction, output tends to fall more and more after a definite period of continuous work, or when spells of continuous work are superimposed (as overtime, &c.) with only short intervals of rest between, and that the fall tends to go further in muscular work than in dexterous or machine work.

2. A considerable fall was found to occur in the average hourly output of days when overtime was worked and also of normal days following the day of overtime. Since additional rates of pay are given during overtime the result was a heavy rise of the wages cost per unit of output.

3. That these overt (and expensive) facts are due largely to fatigue is made more evident still by comparing the hourly output curves first with the daily output curves where the longer interval of the night's rest interspersed throughout the week may account for the lack of appreciable fall toward the end; and secondly, with curves of hourly accidents and spoiled work occurring in the same factory.

4. The marked fall in output during the day seems to be due quite as much to an increase in rest pauses taken voluntarily by the worker as to an actual slowing down. This fact suggests the importance of a policy of authorised rest pauses of a few minutes, such as were given in the operation of soldering buttons in the factory where the analysis was made. Before these recesses were tried a sharp fall in the work curves for the spell and day were fairly universal among the group; after their introduction the same universality attached to the rise in output in the hour immediately following them.

5. Since the tendency of the work curve is different for different types of work it may prove of advantage to adjust the distribution of working hours differently according to the specific strain of the work engaged in.

6. The study of how individuals are related to the type in the matter of industrial output has incidentally suggested a "normal" distribution of individual capacities.

7. By tabulating the output of a number of individuals for every working day and every working hour over a period of several months, some light is thrown on the scientific basis (or reverse) of scientific management. When a time and motion study is made to determine what is a fair day's work it is the fastest man who is usually observed, and it is his fastest record that is finally selected as the datum line. A "delay" allowance of something like 20 per cent. is then made on account of human frailty. This, according to the author's observations, is insufficient. He tabulated 2,080 individual hourly output records of a group of women soldering buttons, apparently at their utmost speed, and found the maximum hourly output from any one individual in the group more than 40 per cent. faster than the group's average hourly output, and more than twice as fast as the instances of the slowest hourly output.

It seems the reverse of logical to deduce what is a reasonable speed from the results of observations which are largely a matter of chance.

Some Effects of Alternating Magnetism.

(*Summary of lecture by* Mr. W. M. Mordey *to Section A—Mathematics and Physics.*)

The speaker prefaced his lecture with the statement that he was about to show the effect produced in powders of various materials by alternating magnetic fields. The apparatus used for the purpose was eight coils so connected that alternate coils were placed in series forming two groups connected to the two phases of a 60-cycle alternating supply. Specular hæmatite, with all magnetite removed, was found to remain unaffected by a unidirectional field, but when subjected to alternating magnetism it acted similarly to a diamagnetic substance—it was repelled from the pole. The effect, however, was not explained by calling specular hæmatite a diamagnetic. When one phase of the supply was switched on the particles of the material were repelled, forming "halos" round the four energised poles. Upon the switching in of the other phase the material was swept along and out at the sides, leaving a clear space over the eight poles. As it could be shown that the effects obtained were not due to lines of force or eddy currents, the speaker suggested that they were to be traced to magnetic hysteresis. The effects of eddy currents upon another material—aluminium—were demonstrated. A sheet of this was placed upon an end pole, when it was immediately swept to the other end. Magnetite powder was shown to be both repelled and attracted, and it was suggested that the attraction due to the high permeability of the substance overcame the hysteresis according to the strength of the field. With a sludge of nickel ore in water the lecturer showed how water could be made to "run uphill"; the repulsion effect upon the ore, combined with the surface tension between the two components of the sludge, caused the water to ascend at quite a steep angle. The rotative effect of the field was demonstrated in various ways, and then the lecturer showed the employment of alternating magnetism to effect the separation of magnetite from sand. By using a current with a very low frequency—one or two periods per second—the effects were slowed down with wonderful and amusing effect; magnetite dust moved deliberately with a "cartwheel" movement from one end of the magnet equipment to the other.

The Mechanism of Gas Ignition.

By Prof. W. M. Thornton.

(*Abstract of paper read before Section G—Engineering.*)

The two modes of spark ignition used in engineering are by disruptive discharge at high voltage and by the arc formed at the point where a circuit is broken. The former is a well-known case of ionisation by collision, but ignition does not depend solely upon the sparking voltage. There is for each inflammable mixture a certain intensity of spark necessary for ignition. Below this it is possible to pass sparks indefinitely without explosion resulting. A certain rate of production of ions is necessary, which bears little or no relation to the total energy dissipated in the spark. Ignition occurs when a critical rate of electrical activation of the combining gases is reached.

The case of the momentary arc at break is less simple. That it is mostly ionic and not thermal has been shown by a long series of observations, in which wide but regular differences between ignitions of various gases under varied electrical conditions have been found. Recent observations on the ignition of hydrogen-air mixtures give more direct evidence of its nature. Working with alternating currents at a frequency of 250 a second and a circuit voltage of 85, the following results were regularly obtained: After breaking a 10-A circuit fifty times in air alone, iron poles being used, ignition of a 35 per cent. hydrogen-air mixture occurred with a circuit current of 0.4 A. After sparking freshly cleaned poles the same number of times in pure hydrogen, ignition of the 35 per cent. mixture could not be obtained with less than 6.0 A, giving a large thick arc. It is clear that this kind of ignition also does not depend upon the energy of the arc, which is 225 times greater in the latter case. Heating the metal in hydrogen to arc temperature destroys that which causes ignition of a subsequent explosive mixture. The direct and only chemical effect of heating iron in pure hydrogen is to reduce an oxide film or to burn out oxygen absorbed in the surface. In cooling, hydrogen may be absorbed; if so its presence greatly retards ignition, though it facilitates electron discharge.

The evidence is that ignition does not depend upon the heat energy of the arc, nor upon the total electron discharge, which is greater since the current is so much larger, but upon the emission of that which is suppressed by the hydrogen. This can only consist of oxygen normally absorbed or absorbed by the poles in contact with air and activated by the combined effect of the thermionic discharge and strong electric field at break.

A Safe Method of Lighting Coal Mines.

By Prof. W. M. Thornton.

(*Abstract of paper read before Section G—Engineering.*)

The remarkable increase in the number of cases of nystagmus amongst coal miners, known to be produced by imperfect lighting at the coal face, calls for improved methods of illumination. The direction in which this has been hitherto sought is by the use of more powerful portable low-voltage electric lamps. The maximum voltage permitted at the face for signalling purposes is 25, direct or alternating, and with this unarmoured cab-tire flexible cables may be used. An evident method of improving illumination is to use 25 V with fixed or portable lamps. The objections raised to any such scheme are solely those of ignition, since shock is impossible at such voltages and the circuits are non-inductive.

Recent observations on the influence of frequency on the ignition of methane (fire-damp) show that by use of much higher frequencies than those now employed for power purposes a higher factor of safety can be obtained. For example, ignition of the most explosive mixture of fire-damp in air, 9.5

per cent., by the break of a 200-V direct-current circuit occurs at 0.5 A. At a frequency of 50 the least igniting current is 6.5 A, while at 160 it rises to 23 A. At a voltage of 20 and a frequency of 160 it is impossible to ignite this mixture with a clean break of less than 150 A. Now the currents taken by 15-W gasfilled lamps suitable for use at the face do not exceed 1 A. There is, therefore, a wide margin of safety possible.

A system now being tested consists of a 160-cycle supply at 15 V, each circuit having about twenty portable lamps. These have double filaments; the shorter of the two, connected to the battery contained in the lamps, gives 2 candle-power, by which the miner travels; the larger one takes 15 V, by which when connected to a plug housed in a heavy movable block, the illumination at the working face can be raised to 15 candle-power or more, the shorter filament being then cut out. In the case of failure of supply, work can be continued, using the lamp battery. Each plug has a special interlocking contact, by which a break of circuit is prevented until the lamp is switched over to the portable cell. There is, therefore, no risk of open sparking. The plug box also contains a fuse, by which, in the event of a short circuit in a lamp, that alone is cut out. The less likely case of a short circuit on the main heavy cab-tire flexible cable, which runs through all the plugs, is provided for by choking coil permanently in circuit, which limits the current to less than that which could cause ignition of a 9.5 per cent. mixture if broken in the open. The system is, therefore, protected by all the usual devices against excess current, but its chief merit lies in the use of currents of such frequencies that, without any other change, the factor of safety is raised to a high value.

Smoke Abatement and the New Bill.

By J. B. C. Kershaw.

(*Abstract of paper read before Section G—Engineering.*)

In this paper the author summarised the provisions of the Smoke Abatement Bill which was introduced into the House of Lords this year by Lord Onslow, and dealt briefly with the previous legislation with regard to smoke prevention.

He said that the majority of people interested in smoke abatement would agree that the existing law was unsatisfactory, and that it was not adequately enforced, but since the chance of passing any amending Bill in the lifetime of the present Parliament was very remote, those interested should turn to voluntary methods of attacking the problem. Factory owners and fuel consumers were often still quite ignorant of the scientific principles of combustion; a smoking chimney was an indication of inefficiency and loss, apart from the effect upon the health of the community. The community should be educated by exhibitions of smoke-abatement appliances, conferences of those interested in the movement for securing a purer atmosphere, public lectures, classes for stokers and engineers, and by the distribution of pamphlets and leaflets.

He had been making inquiries as to what was being done in connection with such education in this country. Before the war nearly all the large towns in this country had started educational classes on the subject. In Liverpool they had most interesting and well-attended classes, but the war had put an end to all these activities, and he was sorry to say that in the majority of towns the classes had not been restarted, although they had been in Glasgow and Manchester. Classes of this kind ought to be started this winter in all the large towns or centres of manufacturing industry, and should be retained even if attendances were rather small. When the classes were first started at Liverpool, some 60 or 70 attended, but in the second season this number dwindled to 30 or 40; that, however, was no reason for giving them up altogether. The manufacturer had to be educated, and if he could be shown that smoke could be minimised or abolished without enhancing costs, he would be willing to help. Stokers and boiler engineers and all classes of the community must be brought within the sphere of educational propaganda, and not until that was done would satisfactory progress be made. As a further aid to educational work among manufacturers, Mr. Kershaw suggested the appointment by the Ministry of Health of fully-trained smoke inspectors. If that could not be done without legislation, the larger municipalities might consider the possibility of appointing highly-trained men as smoke inspectors. If, in all manufacturing towns, there were men of this type, able to meet manufacturers and engineers on an equal footing, an immense step forward would have been taken.

He would also like to see a more satisfactory and uniform system of training stokers and engineers; the system of training stokers as practised by the Verein für Rauchbekampfung (a voluntary society of steam users in Hamburg, formed for the prevention of smoke emission), was the best of all. This organisation was formed in 1902, not only to suppress smoke, but also to obtain greater efficiency in boilers. At the present time it had about 600 members, and some 2,300 boilers, under its control. The nearest approach in the United Kingdom to such a voluntary organisation was the Fuel Economy Department of the Federation of British Industries, which arranged fuel tests, made suggestions to members, and published a quarterly journal, the *Fuel Economy Review*, which contained excellent advice on the economical combustion of fuel. The Hamburg society, however, was more beneficial to its members; it placed at the disposal of the owner of the smallest plant expert advice and technical assistance. Mr. Kershaw hoped that voluntary organisations on the lines of the Hamburg society would be started in the big towns of this country. He also mentioned the importance of producer gas as a means of reducing air pollution. This was being employed abroad for heat-treating steel, yet Sheffield manufacturers continued to assert that it was impossible to make good steel without burning coal and emitting a lot of smoke. A policy of active co-operation was needed. Manufacturers had opposed the Bill which was introduced this year, and that was why he believed that there was no chance of its getting through.

Discussion.

Dr. J. S. Owens said that manufacturers had no desire to co-operate; it was not in their interest to do so, because they did not gain anything from smoke prevention. Practically, the amount of economy to be effected by the reduction of smoke was very small; it was not the person who produced the smoke that suffered. He felt very strongly that one of the first steps to take was to find a method of measuring smoke, because it was of no use to tell a person that his chimney must not emit more than a certain amount unless that amount was defined. Having defined that, they had to go further and say how much smoke a particular industry should be permited to emit. Those were the fundamentals of the problem.

Prof. W. H. Watkinson suggested the education of magistrates. They could solve the problem if they would only impose the fines which they were empowered to impose upon offenders. He considered it would be a good thing to increase the maximum fine from £5 to £50, because it was cheaper for a manufacturer to pay £5 than to carry out the alterations necessary to prevent the emission of smoke.

Mr. Kershaw, in reply to the discussion, urged Prof. Watkinson to do his best to restart the classes which were held previously, and suggested that he should bring pressure to bear on the Health Committee of the town.

THE WORLD POWER CONFERENCE.

The classified programme of this Conference, to which we refer in a leaderette to-day, shows that the National Committee for Great Britain will consist of Mr. B. Longbottom (chairman of the Executive Committee), Col. R. K. Morcom, C.B.E. (vice-chairman of the Executive Committee), and Mr. C. Rodgers (secretary of the Executive Committee). The Institutions of Electrical, Civil, and Mechanical Engineers will also be represented on the committee.

Mr. D. N. Dunlop, who was, we believe, the originator of the scheme, is of course the organising director. Mr. Roger T. Smith is chairman of the Programme Committee, Lieut.-Col. C. M. Norrie, secretary of the Water-Power Section, and Mr. A. J. Dannhorn, secretary of the Engineering Section.

There will be five main divisions, as stated elsewhere, and in due course a full programme of the 150 to 200 papers to be presented by the various national committees will be issued. At present we have to be content with publishing the following list of papers arranged by or under the consideration of the British National Committee:—

Papers Arranged to Date.

Section A.—"The Coal Resources of the World," Sir Richard Redmayne, K.C.B.; "National Review of Water Power in Great Britain and Ireland," Prof. A. H. Gibson, D.Sc.

Section B.—"Problems relating to Run-off, Storage, and the Allocation of Catchment Areas in Great Britain and Ireland," W. J. E. Binnie; "Points affecting Economy in General Lay-out and Design," C. M. Norrie and W. H. Munro; "The Scope of Development to meet Progressive Demands," E. C. Bergstrom.

Section D.—"Steam Generation," Sir James Kemnal, Kt.; "Steam Turbines," the Hon. Sir Charles Parsons, K.C.B., F.R.S.

Section E.—"Internal Combustion Engines," James Richardson.

Section G.—"The Transmission and Distribution of Electrical Energy," C. H. Merz; "Large Generators," A. B. Field; "High Voltage D.C. Generation and Distribution of Electrical Energy," J. S. Highfield; "Mechanical and Hydraulic Variable Transmission of Power," Dr. H. S. Hele-Shaw, F.R.S.

Section H.—"The Application of Electrical Energy," Sir Alexander Kennedy, F.R.S.

Section K.—"Application of Power to Rail Transport," Roger T. Smith and C. B. Collett; "Application of Power to Road Transport," Col. R. E. Crompton, C.B.

Section L.—"Illumination," C. W. Sully.

Section M.—"The Financial Aspect of Hydro-electric Development," George Balfour, M.P.

Section N.—"International Standardisation," C. le Maistre, C.B.E.; "The Education of the Apprentice," Prof. A. P. Lawrie, D.Sc., and Prof. F. G. Baily; "The Education and Training of the Engineer of the Future," A. P. M. Fleming, C.B.E.; "The Importance of Greater Public Interest in Mechanical Progress," T. C. Elder; "Co-operative Publicity in the Public Supply of Electricity," J. W. Beauchamp; "The Study of the Human Element in Production," D. R. Wilson; a paper by Dr. C. S. Myers, F.R.S.

PAPERS UNDER CONSIDERATION.

Section A.—"National Survey of Fuel Resources"; "Oil Resources."

Section C.—"The Winning and Utilisation of Peat"; "The Winning and Utilisation of Lignites"; "The Design and Operation of Gas Producers"; "The Utilisation of Powdered Coal."

Section D.—"Steam Generation and Utilisation at Higher Temperatures and Pressures"; "Modern Developments in Reciprocating Engines."

Section E.—"The Mechanism of Combustion of Gases."

Section G.—"Power Factor Improvement"; "High Voltage Underground Cables."

Section H.—"Recent Research in the Economic Utilisation of Electrical Energy."

Section K.—"Application of Power to Water Transport"; "Application of Power to Air Transport."

Section N 6 (a).—The British Empire Producers' Organisation, with the consent of the Conference Executive Committee, is undertaking to present special papers on British Empire resources in relation to power:

"The Mineral Resources of the British Empire as bearing on Power Machinery"; "Alcohol as a Source of Power"; "Power Areas and Possibilities of Industrial Development."

SCIENTIFIC AND INDUSTRIAL RESEARCH.

THE COMMITTEE'S REPORT.

THE report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1922-23 has been presented to Parliament.* It shows that during the year under review the expenditure of the National Physical Laboratory amounted to £164,906. Of this sum £49,404 was provided from fees for tests and special investigations for outside bodies, and £32,025 from repayments from the Service departments. For the current financial year routine tests and scientific services, not of the nature of research, undertaken for the civil departments of State, are to be carried out on repayment terms.

The expenditure on the work of the Fuel Research Board amounted to £40,695. This sum includes the cost of work at the station, £37,437; the cost of research carried out elsewhere, £4,798; and other expenditure, £3,258. It does not include grants made on the recommendation of the Fuel Research Board to the Manchester City Council for research on domestic heating, &c.

The number of industrial research associations which have received licences from the Board of Trade is 25, and, of these, 22 are in actual operation. Grants to associations amounted to £95,345, and eight grants were made in aid of scientific investigations conducted by other bodies, of which six were in continuation of previous grants; 304 grants were made to research workers and students-in-training.

The total expenditure of the department during the financial year 1922-23 was £497,549, made up of £264,493 from the Exchequer, £48,103 from the interest on the Milton Fund, £95,345 from the capital of the fund, and £89,608 from fees for tests and special investigations for outside bodies, from contributions towards research funds for the Froude Tank and the ferrous alloys research, and from repayments by the Service departments. The saving on the estimate, due to the restriction of the research programme effected under the direction of the Advisory Council, made it unnecessary to call on the grant-in-aid of £39,500 voted by Parliament in 1921-22 for the unforeseen developments of researches undertaken by the Department, and this grant-in-aid has been carried forward to 1923-24.

The Advisory Council has considered the future position of the research associations established in connection with the Department, since several of them are rapidly approaching the end of their quinquennial grant periods, and one has completed its first five years of work. It will be remembered that negotiations took place with each industry desirous of availing itself of the scheme, and a minimum subscription income over the period decided on was agreed as the necessary condition of a grant. In respect of this agreed minimum, and up to a higher agreed figure, the Department offered to make grants on a £ for £ basis. Beyond the second limit further grants would only be made in so far as funds were available, and would be on a progressively diminishing scale. Only seven associations out of 22 in actual operation have so far exceeded this second limit. The majority have done little more than reach the minimum. This aspect of the scheme is disappointing, for it was hoped that at the end of the appointed period all the associations would have become completely self supporting. The anticipations made at the inception of the scheme have failed to be realised, owing in large measure to industrial events since that date.

Few, if any, of the associations coming under review had succeeded in establishing themselves on an adequate and independent basis. Where failure has arisen it cannot be ascribed to incurable apathy on the part of the industries or to incapacity on the part of the associations or their officers. Accordingly, in some cases further aid from the Million Fund is necessary and desirable if the original intentions of Parliament in voting the money are to be successfully carried out.

At the same time, although the five years of grant appear likely to be insufficient in many cases to fulfil the original hopes of the scheme, circumstances have changed materially, and therefore the present agreements will be terminated at the close of their currency.

If, however, any association should apply for further assistance, its application will be considered on its merits, and to this end an inquiry into the operation of the association should be made.

In any new contract it should be made perfectly clear that, at its close, no further financial assistance will be forthcoming under any conditions. A still more important feature of the new contracts will be the necessity for a continuously increasing effort on the part of the industry concerned so that it may shoulder the financial burden of the association to a larger degree in each succeeding year. It may also be desirable for the Department to maintain a more intimate touch with the activities of the associations; the appointment of a representative of the Department on the managing council without voting powers might best serve this purpose. The recommendations outlined above have been accepted.

The work of co-ordinating research boards and committees has been of increasing value during the past year; not only the Service, but also the civil, departments are coming to the boards for advice and help in investigations of importance to their administration.

The co-operation of the various departments, both civil and military, in the work of the Radio Research Board is especially close, and the work of the Board is receiving general recognition both at home and abroad. The Admiralty is to assist the Board by providing facilities for investigators to study certain problems of interest to the Board in the Indian Ocean.

While the Government facilities for general researches in physics and engineering are at present sufficient for the purposes of the boards, the facilities for research in chemistry, apart from those of direct and often of sole interest to the Service departments, are comparatively small. This lack of facilities is a severe handicap.

Sir William Bragg's work, apart from its great scientific interest, has been of great practical significance in the present state of industrial development, and arrangements have been made to supply Sir William with facilities required for the adequate prosecution of his researches. The co-operation of the Royal Aircraft Establishment with the British Electrical and Allied Industries Research Association in investigations on moulded insulating materials has produced results of value.

The tests of the suitability of various types of river current meters for use in this country have been practically completed and the final report of the Committee is being prepared. It is proposed to include a summary of the information available as to the use of weirs for gauging small streams. There is no further work which the Committee can usefully undertake pending the establishment of an authority to carry out a complete survey of the water resources of the country.

Concerning problems of illumination, the Department called a conference of representatives of the Medical Research Council and interested Government departments to consider the matter in all its aspects and a committee of the Department has been set up under the chairmanship of Mr. C. C. Paterson, O.B.E., with the following terms of reference:—

* H.M. Stationery Office. Price 4s. net. Cmd. 1,937.

(*a*) to consider, and advise on, requests from other departments for investigations in connection with the lighting of buildings and allied problems; and to supervise such investigations if approved by the Advisory Council;
(*b*) to co-operate with the Medical Research Council by making arrangements for and supervising physical investigations needed in connection with physiological researches on illumination;
(*c*) to examine the need for general researches on illumination, to make such recommendations to the Advisory Council as they may consider desirable, and to undertake the supervision of approved investigations.

During the past year 668 applications for grants to individual research workers and students-in-training were considered, as compared with 544 last year, and 304 awards have been made, an increase of 24 on those made last year. The applications for grants received for the academic year 1923-24 confirm the expectation that the conditions in universities and colleges should now be regarded as in the main stabilised.

The recommendation of the Executive Committee of the N.P.L. that a building for testing electrical e.h.p. apparatus and equipment should be immediately provided has been sanctioned by the Treasury and funds have been provided for its commencement during the current year. The building will be planned so as to be capable of ultimately dealing with pressures up to 1,000,000 volts.

The remainder of the report summarises the work of the Research Boards and Committees of the Department, which now number 40.

An appendix shows that the aided researches number 15 and industrial researches number three. Of the eight appendixes one deals with developments in the organisation of research in India, Egypt, and the Overseas Colonies, and another with State research in France.

THE WORK OF THE ELECTRICITY COMMISSIONERS.

THE ANNUAL REPORT.

The report of the Electricity Commissioners on the work of their department for the year ending March 31st, 1923, was issued last week (H.M. Stationery Office; price 2s. 6d. net), and is abstracted below.

In their prefatory remarks the Commissioners state that the principal features of the period were the general improvement in the electricity supply industry of the country and the enactment of the Electricity (Supply) Act, 1922. Thanks to improving trade, lower prices of coal and plant, and the reduced cost of labour owing to the decline of the cost-of-living index figure, the demand for electricity increased and the cost of production fell, so that the majority of supply undertakings showed satisfactory financial results. In a number of cases the domestic load was primarily responsible for the increase in output; in others, the power load improved. There was a general lowering of charges for electricity, and large extensions were undertaken. There is, however, much leeway to be made up before home trade generally, and the supply industry in particular can be regarded as operating on a normal basis.

On March 31st, 324 local authorities, 212 companies, and 8 persons were authorised undertakers in Great Britain, an increase of nine local authorities and one person compared with the previous year. A complete list of such undertakings, giving the leading particulars regarding each, is in the Press. A list of non-statutory undertakings is being prepared with the assistance of the Post Office Engineering Department, and a census of the owners of all generating plant in operation in Great Britain is in contemplation, a large amount of information being already available from the Coal Mines Department.

In July, 1922, the Minister of Transport authorised the Commissioners to deal with the breaking-up of private streets railways, and tramways, and the supply of electricity to railways, tramways and canals partly outside an area of supply.

Reorganisation of Electricity Supply.

During the past year no further electricity districts were provisionally determined. The passing of the 1922 Act enabled the Commissioners to proceed with the schemes for the London and Home Counties District and the Mersey and West Lancs. District. Four draft orders were published, embodying approved schemes for the purpose of further local inquiries (North Wales and Chester, London and Home Counties, South-West Midlands, and South-East Lancs.), which were duly held; orders have been confirmed subsequently in eacn case except that of London, which was deferred. Two other draft orders have been published since March 31st (Mersey, and East Midlands), and three are in preparation (West Riding, North-West Midlands, and Edinburgh). Eight local inquiries were held—four first and four second; particulars of the former are appended to the report, and summaries of the second inquiries are given (these have been reported in the Electrical Review). With regard to the West Riding (Aire and Calder) Electricity District, the Commissioners remark that the efforts of the principal parties and of themselves to arrive at an equitable settlement have involved very protracted negotiations, which have not only delayed the completion of the approved scheme, but also have embarrassed the Commissioners in dealing with other matters, some of an urgent character, relating to different portions of the District, seven applications for Special Orders in respect of areas within the District having been received in 1921. In December, 1921, a joint conference was held, and a committee consisting of the city electrical engineers of Leeds and Bradford and the engineer and manager of the Yorkshire Electric Power Co. was appointed to investigate the question of "agreed areas," and reported in May, 1922. The Power Co. and the Corporation of Leeds informed the Commissioners that they were disposed to accept the proposals of the report, with reservations, but the conference of local authorities was unable to do so. Many interviews with the Commissioners followed, but a full settlement was not achieved by the end of March last, when the Commissioners were still endeavouring the bring about an agreement. The outstanding points of difference between the Conference and the Corporation of Huddersfield on the one part and the Power Co. on the other related to the inclusion or non-inclusion in the "agreed area" of certain local government districts in areas for which the Corporation and the Electrical Distribution of Yorkshire, Ltd., had lodged competing applications.

General Observations.

The 15 Electricity Districts which have been provisionally or definitively delimited include the most important industrial areas in Great Britain, with the exception of the North-East Coast area, and the local inquiries which have been held in respect of 13 of them have established the definite advantages to be derived from the reorganisation of electricity supply—as well as the difficulties to be overcome. The salient facts which have emerged are the immense scope for the further development of public supplies of electricity, for industry and for domestic purposes, not to speak of railway electrification; the great economies to be effected by joint action in lieu of individual development; and the extent to which engineering considerations are affected by the numerous interests involved.

For 12 districts, responsible for more than 50 per cent. of the whole of the public supplies of electricity in Great Britain, the maximum demand in 1921 was 1,146,860 kW; it is expected to reach 2,040,675 kW in 1926, and 2,937,090 kW in 1931. The output was 2,632 million kWh; it is expected to be 4,990 millions in 1926, and 7,356 millions in 1931. The Commissioners regard these figures as reasonable, or even conservative, pointing out that in some cases during the past year the growth in output has been approximately that previously estimated for the first quinquennial period.

The Commissioners are impressed with the extent to which private generating plant has been installed by manufacturers and trading associations. In one district the private plant installed by collieries and other industrial undertakings largely exceeded the total capacity of the plant installed by the whole of the authorised undertakers. The small size and relatively high running costs of many of the public supply stations have hitherto had an adverse effect upon the application of electrical energy for power purposes in industry, and manufacturers have often found it more advantageous to install their own generating plant than to take a supply from a public source. The present tendency is for manufacturers to have recourse to public supplies, if available at satisfactory rates. There is no doubt that the reduced costs and increased reliability resulting from the centralisation of generation in electricity districts will serve to accentuate this tendency, and also lead to the gradual discarding of much of the private generating plant at present in operation. Where large private generating stations have been installed by reason of special circumstances, for example, by colliery undertakings, supplies in bulk are already being given from private stations to authorised undertakers; arrangements advantageous to the district and to the owners of the private generating station might be entered into with regard to surplus, reciprocal, or stand-by supplies; for interconnection of the respective transmission systems; or for the use by the public supply authority of portions of the transmission system of the private undertaking. The reorganisation of supply in particular districts may therefore react to the general benefit of all concerned through co-operation of the kind indicated.

With regard to the second point, the evidence given at local inquiries has established, beyond doubt, that large economies are possible by the re-organisation of electricity supply,

but it would be premature, at the present stage, to attempt to forecast the extent of the economies which will be realised in actual practice when approved schemes for various districts have been brought into operation, for two reasons. In the first place the possible economies will be largely dependent upon the extent to which the authorised undertakers in a district are prepared to co-operate in the centralisation of generation, in the pooling of the resources of the interconnected stations for the common good, and in discontinuing the use of relatively inefficient or badly-placed stations. In the second place, the actual economies will be governed to some extent by the fluctuations prevailing from time to time in the cost of coal, materials and plant, in rates of wages and in the cost of raising capital. Generally speaking, the Commissioners have formed the view that the estimated savings in the case of a number of districts have been based upon conservative anticipations of the effects of reorganisation, and that in practical working such anticipations are likely to be exceeded, particularly as regards the conservation of coal consequent upon the centralisation of generation.

With regard to the third point, the further experience of the Commissioners points to the conclusion that only in a few districts where the circumstances are exceptional will it be found practicable to formulate and give effect to an *engineering* scheme of reorganisation dictated by electrical considerations alone. In the majority of cases the engineering problem has not proved capable of dissociation from the particular interests of the various authorities in a district, with the result that compromise has been necessary, in order to secure the adherence and co-operation of the authorities concerned.

Reference is made to the important question of the transfer of generating stations and main transmission lines to a Joint Electricity Authority. It is laid down in the Act of 1919 that a Joint Authority, with the consent of the Commissioners and by agreement with the owners, may acquire such works on such terms as may be agreed; also that, subject to the provisions of the Act, a scheme establishing a Joint Authority may provide for the transfer to the Joint Authority of the whole or any part of the undertaking of an authorised undertaker in the district concerned upon such terms as may be provided by the scheme. The former provision connotes settlement after the establishment of the Joint Authority, whereas the latter would enable agreed terms arrived at before the coming into operation of a scheme to be embodied in the scheme itself.

In cases where a scheme of reorganisation is framed on the definite premises that certain generating stations and main transmission lines will be transferred to a Joint Authority, it is apparent that the contemplated centralisation of generation and also the economies to be derived therefrom might be seriously affected in the event of individual authorities afterwards deciding not to transfer their stations, or requiring terms which would absorb an undue proportion of the advantages otherwise derivable from consolidation.

Where agreement in principle to the transfer of generating stations has been expressed at local inquiries it has appeared to the Commissoners, for the reasons indicated above, that agreed terms should, if possible, be included in the approved scheme. The procedure therefore followed in preparing certain draft orders has been to make provision for the transfer of particular stations and main transmission or interconnecting lines, and also for the terms of such transfers on a basis which, in the opinion of the Commissioners, would permit of an equitable settlement, such provisions being subject to consideration at the further local inquiry into the approved scheme and also to ratification by the individual authorities concerned. The question whether the problems associated with the transfer of generating stations can be satisfactorily resolved by this procedure remains to be determined, but indications are not wanting that it may ultimately be found necessary to defer the settlement of the details of such matters until after the establishment of the Joint Electricty Authority for a district.

Generating Plant.

The aggregate plant capacity of the new stations and extensions of existing stations sanctioned by the Commissioners during the year amounted to approximately 422,000 kW as compared with a figure of approximately 169,000 kW for the preceding year. The figures, however, cannot be regarded as affording more than an approximate measure of the relative rates of development, as the former figure includes a number of consents in respect of important applications which were under consideration during the previous year.

The consents under Section 11 of the Act of 1919, issued by the Commissioners since their establishment, represent a *gross* addition of 1,279,088 kW to the plant capacity of authorised undertakers, railway and tramway authorities, and non-statutory undertakings, about 90 per cent. of the sanctioned plant being for use in England. The *net* addition, however, is somewhat less than the figure quoted owing to the replacement, in a number of cases, of inefficient or obsolete plant by the new plant which has been sanctioned.

Of the total generating plant sanctioned, about 29 per cent. was for new generating stations and 71 per cent. for extensions of existing stations. The division of the total as between the various authorities was as follows: Local authority undertakers, 65 per cent.; company undertakers, 29.4 per cent.; and railway and tramway authorities and non-statutory undertakings, 5.5 per cent.

The schemes of reorganisation approved or contemplated by the Commissioners involve the continued utilisation of the most economical of the existing stations in the various districts, and a large number of the consents given during the past three years to the installation of additional generating plant related to stations of this class.

The total plant capacity of the extensions sanctioned throughout the country in respect of authorised undertakings during the period in question was 850,845 kW, the extensions of the principal generating stations in nine electricty districts accounting for 582,750 kW, or 68.5 per cent. of the total. These figures afford an indication of the extent to which it has been possible for the Commissioners, during the transition period, to control development along lines which will accord with the engineering schemes for different districts.

The applications relating to the establishment of new generating stations which were under consideration by the Commissioners during the year are indicated below, a summary of the action taken on each being given.

County of London Electric Supply Co., Ltd.—On June 13th, 1922, the Commissioners issued their formal consent to the establishment by the company upon the Barking site of a station designed to contain 100,000 kW of generating plant and approving generally of the establishment of necessary main transmission lines from the site to or within the areas of supply of the company, subject, *inter alia*, to the submission of plans and drawings prior to the commencement of work and to the company's proving that the prices to be paid in respect of the said works were fair and reasonable. The consent also prescribed the basis for the determination (unless otherwise agreed) of the purchase money payable to the company in the event of a Joint Electricity Authority requiring the company to sell the Barking station.

Greenock Corporation.—An application was made to the Commissioners by the Corporation for consent to the establishment of a generating station at the works of a sugar refining company where a large proportion of the steam raised at a high pressure was used for process purposes at a low pressure. Under an arrangement made between the parties, it was proposed that the Corporation should install generating plant at the refinery for the purpose of utilising the waste energy represented by the difference between the steam pressures, the electricity thus generated to be used in part for the requirements of the refinery, and in part for the purposes of the undertaking of the Corporation. The scheme was approved by the Commissioners, and formal consent was given to the establishment, by the Corporation, of a station to contain 1,500 kW of generating plant.

Preston Corporation.—The Commissioners issued their formal consent on May 12th, 1922, to the establishment of a new station to contain initially 20,000 kW of generating plant.

Salford Corporation.—The Commissioners issued their formal consent on June 21st, 1922, to the establishment of a new station on the Agecroft site to contain initially 37,500 kW of generating plant.

Shropshire, Worcestershire and Staffordshire Electric Power Co.—The construction by the power company of a new generating station at Stourport constituted an essential feature of the re-organisation of electricity supply in the South-West Midlands District. Application was made by the company to the Trade Facilities Act Advisory Committee for a Government guarantee in respect of the capital required, and was referred to the Commissioners for their advice; subsequently the Treasury decided to give the required guarantee. The Commissioners issued their formal consent on September 6th, 1922, to the establishment of a new station to contain initially 12,500 kW to 15,000 kW of generating plant.

South-Eastern and Chatham Railway.—An inquiry was held in May, 1922, in respect of the applications of the railway company and the West Kent Electric Co. for consent to the erection of new generating stations, which was withheld. In October, 1922, the London Electric Supply Corporation, Ltd., informed the Commissioners that it was in negotiation with the railway company with the view of entering into an agreement to provide the supply required for the suburban electrification scheme, and the Commissioners notified the Supply Corporation that they would give the necessary consent on being satisfied that a definite arrangement had been concluded with the railway company.

Consents to the establishment of new generating stations were also given by the Commissioners to the Crowborough District Gas and Electricity Company (225 kW); Northern Counties Electricity Supply Co., Ltd. (250 kW); Sidmouth Urban District Council (102 kW); Warminster Electric Supply Co., Ltd. (125 kW); and York Corporation (875 kVA).

The Commissioners issued consents to the establishment of 18 new generating stations in connection with non-statutory undertakings, including Bideford and District Electric Supply Co., Ltd. (200 kW); R. G. Cross, T. E. Crawter and C. W. Seward, of Petersfield (130 kW); Elgin Electric Supply Co., Ltd. (150 kW); Norchard Syndicate, Ltd., of Lydney (10,000 kW); Stevenage Electric Lighting and Power Co. (165 kW); and Sussex Electricity Supply Co., Ltd., Littlehampton (134 kW).

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Test Room Rheostats.

Fig. 1 illustrates a test room rheostat for potentiometer or series regulation made by Messrs. Donovan & Co., 47, Cornwall Street, Birmingham. It is made in two standard sizes, *viz.*, 8A throughout by 33 ohms resistance, and 4A throughout with 100 ohms resistance. The rheostat has a cast-iron frame,

Fig. 1.—Test Room Rheostat.

with a black finish, and a sheet steel cover, mounted on a pitch-pine stand. Best Welsh oil-slate is employed in the apparatus, and the resistance wire is of a non-corrodible copper-nickel alloy with a temperature coefficient of approximately .00022 per 1 deg. C.

The "Lightning" Sheet-metal Cutter.

The Selson Engineering Co., Ltd., 83 and 85, Queen Victoria Street, E.C.4, has produced a simplified model of its "Lighting" sheet-metal cutter (fig. 2) for dealing with iron, brass, steel, copper aluminium, &c., sheet of thicknesses up to 3/32 in. It is claimed that up to this limiting thickness the metal is sheared as fast as it can be fed. The machine is

Fig. 2.—The "Lightning" Sheet-metal Cutter.

power driven either by a pulley or by direct coupling to a ½-h.p. motor. The shear blades make from 800 to 1,200 strokes per minute.

For cutting large and heavy sizes to irregular shapes, the cutter can be detached from the machine and driven by a flexible shaft fitted to the eccentric shaft, the opposite end of the flexible shaft being provided with a tapered shank so that it can be connected to an electric or pneumatic drill, or any revolving spindle. In this case, two handles for guiding the shear are bolted on. The body of the machine consists of a drop forging to which is fitted an eccentric shaft, fulcrum pin and plate, and ball races. All the parts are of steel specially heat treated where necessary. It is stated that the machine will cut through 40 in. of steel plate in 30 seconds, leaving a clean-cut edge without burr, and without bending the material.

New "Ellison" Rotor Starters.

To meet the need of a rotor starter for infrequent use, not intended to be used for speed regulation, Mr. George Ellison, Perry Barr, Birmingham, has introduced a new pattern. These starters are totally enclosed and unventilated; they are weatherproof and dust-tight and are suitable for installation in the open air, or in workshops, mills, non-fiery mines, &c. Fig. 3 shows the exterior of one of these starters, and fig. 4 illustrates the internal construction of the larger of

Fig. 3.—New Rotor Starter (Exterior).

the two sizes in which they are produced. The fixed contacts are mounted on a mica-covered slate base; they are of brass (except the final contact in the larger size, which is of copper) and are easily renewable. The complete dial is mounted on a cast-iron spider, which is secured to the cast-iron case by three screws. When these are unfastened the starter, complete with dial, resistance, connections, terminals, and moving contacts, can be removed from the case. This greatly facilitates erection, inspection, and repair. The moving contacts are copper brushes of ample section and contact

Fig. 4.—New Rotor Starter (Interior).

surface. The resistance elements consist of a wire of high-resistance alloy, with negligible temperature coefficient, wound on strong threaded stoneware cylinders. These cylinders are carried on split mild-steel tubes, which fit the bore closely.

The cover is a domed iron casting, bearing on the exterior the operating handle, pointer, and retaining hook, and on the interior a slotted driving arm, which engages with the brush spider, and a powerful spiral spring, which returns the brush contacts to the "off" position. A slow-motion worm gear, for giving a quick movement from contact to contact, with a pause at each, can be fitted. A pamphlet (No. 66) has been issued giving full particulars of motor and cable sizes, details of rating, erection, &c., and much other information.

THE B.L.I.C. ELECTROLYTIC DYNAMO AND BATTERY REGULATOR.

A New System of Automatically Controlling the Supply of Electricity on Automobiles.

The problem of fully and properly controlling the supply of electricity through the electrical equipment of a motor vehicle is a complex one, which has hitherto not been solved in a completely satisfactory manner. The dynamo, which supplies the current, is driven by an engine the speed of which is constantly varying and, at the same time, it has to deliver its supply to a battery which at one time may be fully charged and at another almost completely discharged. Further complication is introduced by the fact that practical considerations call for the elimination of delicate regulating mechanism which requires to be accurately adjusted and subsequently re-adjusted at more or less frequent intervals.

In the system now almost universally employed the dynamo is induced to charge the battery over the entire range of engine speeds by the incorporation of an auxiliary brush connected to a field coil, which gives the desired regulation. Unfortunately, however, the three-brush dynamo, unless supplemented by some external controlling device, has a very bad fault, *i.e.*, when the battery is in a discharged state the charging rate is at its lowest, though it should be at its highest; and when the battery is fully charged the charging rate is at its maximum, when it should be at its minimum. Thus, if the battery becomes exhausted, charging proceeds slowly instead of rapidly, and when it is fully charged current is wasted and the electrolyte is boiled away, the battery plates at the same time suffering deterioration.

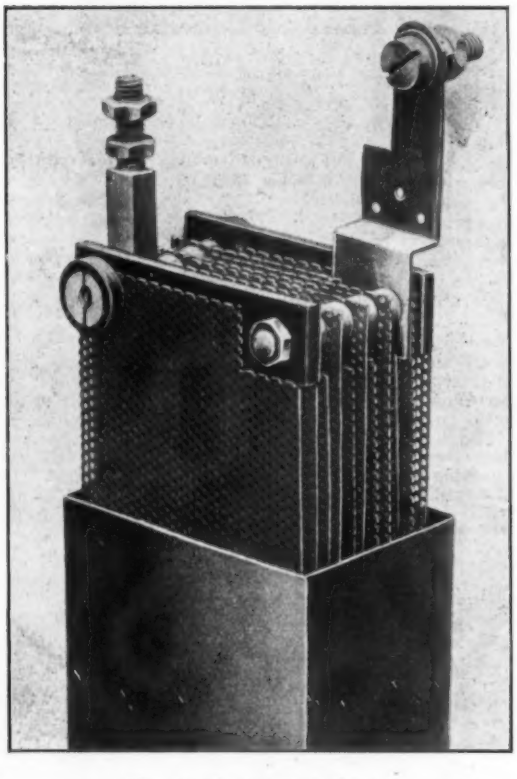

Fig. 1.—Electrolytic Cell.

Evidently, what is wanted is a sort of electrical "safety valve" that will side-track the current when the battery is fully charged and, as it becomes exhausted, will gradually close until (when the battery is empty) it will allow the charging to proceed at a really good rate. Such a "valve" should also protect the system against the effects of accidental breakages or loose connections, which are dangerous, because they disconnect the battery and subject the lamps to too high a voltage.

The new system evolved by the British Lighting & Ignition Co., Ltd., differs from any previous methods suggested as remedies for the fault explained above, inasmuch as it involves no mechanical contrivance which requires adjustment and operates automatically.

The B.L.I.C. electrolytic regulator consists of a number of small sheet-steel compartments containing sheet-steel plates, fig. 1, immersed in an alkaline solution. The plates are connected in positive and negative groups and the groups of plates in the various compartments are joined in series, exactly as are the plates in a battery. There are, for instance, six compartments in a regulator for governing a 12-volt battery. The whole regulator weighs no more than a small fraction of the weight of the battery it controls.

When current is sent through a regulator of this kind the effect is to decompose the water, liberating the hydrogen and the oxygen of which it consists. This process requires a pressure of approximately two volts, so that six such cells in series require a pressure of 12 volts.

The regulator is connected, as shown in fig. 2, in parallel with the battery. Now, if the voltage of the battery is below 12 volts it is insufficient to start the regulator working and all the current goes to charge the battery. When the voltage rises above twelve the regulator begins to side-track some of the current, reducing the output of the dynamo and diverting some of the reduced output, so that the battery gets less current. When the battery is fully charged only a "trickle of current" passes through it, the rest of the reduced output of the generator being diverted through the regulating cells.

Thus, without any mechanical contrivance, we have a perfectly safe means of regulating the current so that an empty battery is rapidly re-charged and a full battery is merely kept up to the mark and not overcharged. The battery is, in fact, always employed under efficient conditions and the need to use an unnecessarily large dynamo is thus eliminated; moreover, it must be remembered that, with an unnecessarily large dynamo, excessive overcharging is almost sure to take place at times, with resulting damage to the battery.

The only attention that the motorist need ever give to the regulator is to add water to it very occasionally. Even if the level of the water falls considerably the regulator will continue to function so long as a reasonable proportion of the surface area of the steel plates contained in it is immersed in the solution. In other words, the most that can be required is to add a little water to the regulator whenever water is added to the battery itself. The steel plates in the regulator are not acted upon chemically, so that the life of the regulator should be very long.

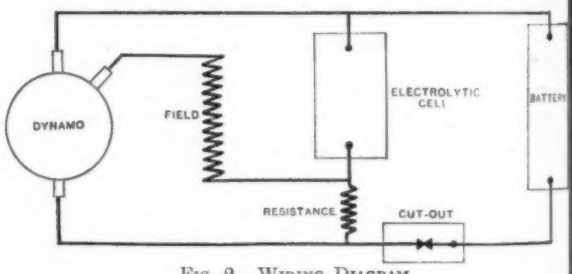

Fig. 2.—Wiring Diagram.

The advantages of the new system will be obvious. It is claimed that the regulator will maintain the battery in a better condition than has hitherto been possible and thereby considerably increase its capacity, irrespective of the conditions of running or the varying speeds of the engine.

The regulator can be applied to any system in which the now almost universal three-brush dynamo is employed, and its introduction involves no change in the dynamo or in the battery. If, however, the regulator is installed in the first instance, the more efficient conditions of use of the battery and dynamo may enable smaller units to be used to obtain the same results, thus covering the cost and weight of the regulator.

It is understood that the B.L.I.C. system of automatic regulation is being introduced, in the first instance, for large motor cars, the more complete electrical equipment of which derives the greatest advantages from the new system. It is, however, applicable to any size of car, and will be available for the smaller cars also at a later date.

"The Same Old Lie."—A short time ago fire caused £100,000 damage at a big flour mill at Doncaster, and the Press report, as usual, finished: "The outbreak is thought to have been due to the fusing of an electric wire." This was promptly taken up by Mr. Sydney A. Windle, of the Doncaster Corporation electricity works, who, in a letter to the Press, said: "In the interests of many users of electricity, I am authorised by Messrs. Hanley & Sons (the owners of the mill) to say that there is no evidence whatever to show that the outbreak was due to electricity, or how the fire originated." If electricity officials would generally follow the example set by Mr. Windle, when such assertions had no foundation, it would be the merest justice to the electrical trade and electricity.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Safety at Sea.

As a marine engineer of many years' standing, I was rather interested in the letter of "Torpedoed" with reference to your report on "Life-saving Appliances"; but I regret that he found it necessary to make such unfounded remarks and charges against that splendid body of men, the marine engineers.

I think my sea-going electrician friend is very much mistaken in his views, and it is a pity he spoils what would have been a good letter by indulging in cheap sneers, and very ignorant remarks regarding the abilities of marine engineers in general.

Permit me to point out to him that the very fact (which he states) of shipowners not requiring any special electrician, or wiremen, means that the shipowner and his superintendent engineer are fully aware that the junior engineers on board are quite qualified to do all the repairs and maintenance of the electrical plant in their charge.

If "Torpedoed" were more fully acquainted with the B.O.T. regulations regarding the examinations for certificates of competency he would find that it needs a man with brains to pass that examination. His practical and theoretical knowledge has to be very high, and his knowledge of electricity is certainly far from vague, and is not a side-line by any means.

Breakdowns at sea of either the electrical or propelling machinery are very rare occurrences, and in the event of a breakdown, the chief (unlike the power station man) cannot call in the assistance of a large maintenance staff and outside advice.

He just tackles the job with his juniors and gets the work done without any fuss.

Eminent electrical engineers fully recognise the fact that, as a rule, the most successful electrical engineers are evolved from good mechanical engineers, and when "Torpedoed" eventually resigns his seafaring career for a shore appointment, he will be rather surprised to find what a large percentage of the technical staff in our modern power stations were "once upon a time" junior marine engineers, and these gentlemen will, I am sure, fully endorse my remarks.

Marine engineers, as a body of men, are the pick of the merchant service.

The Middle Watch.

October 4th, 1923.

I was very interested to read the letter of "Torpedoed" in your issue of September 28th. It is seldom that we get the views of electricians on ships in your paper, and as this branch of engineering is one which is growing so rapidly, and is likely to continue to do so for the next few years at an even more rapid pace, owing to the introduction of the Diesel vessel, I think that your readers will welcome a little light on the matter.

Your correspondent is evidently a practical ship's electrician, and there is a good deal of sound common-sense in what he says. He is perhaps not quite fair in his summary of the actions of the shipowner, who has at the present time anything but an enviable task before him. It is general knowledge that at present it is almost impossible to make ends meet on steam-driven ships, and there are very few of these now running which can more than cover their establishment charges. On the other hand, Diesel-driven vessels, owing to their very much greater economy in fuel costs and their more efficient electrical auxiliaries, both in the engine-room and on decks, are still able to hold their own. But even here the strictest economy has to be maintained and all "frills" eliminated, in order that the balance may be kept on the right side. This state of affairs is reflected in the fact that at present no shipowners are contemplating new tonnage, except those ships which are driven by the internal-combustion engine, and that most of the big lines are making the best of their steam-driven ships by converting them into oil fuel burners. Once oil fuel is adopted, whether direct in the cylinders or under the boilers, the tendency is of course to dispense with coal altogether and to use electricity for driving engine-room auxiliaries and deck machinery, such as winches, capstans, windlasses, and steering gear, as well as for heating and cooking. This, of course, tends to still greater economies; in fact it is probable that the saving obtained in this direction is more than in the conversion from coal to oil in the main engines of the steam-driven ships.

"Torpedoed" draws attention to the fact that the life-boats in many vessels are practically useless except in the calmest weather and when there is ample time to launch them, and this is, as he points out, not by any means always the case. To a very large extent this state of affairs is due to the panic legislation which, after a certain catastrophe, stipulated "Lifeboats for All." The result was that boats had to be piled on the decks to such an extent that there was very often not enough room to work them efficiently, and in a crisis it might be that the conditions would be worse than if fewer boats had been installed and the deficit made up by the provision of rafts, which are easily stacked and can be launched in any weather. However, the method of launching life-boats is improving almost every day, and all the newer vessels, including those of the lines mentioned by "Torpedoed," are being fitted with appliances which, except under the most unfavourable conditions, can be relied upon to deal with the boats easily with the crew available. In some of the more up-to-date vessels there is provided means, by electrically-operated "flip-flaps," of lowering the boats 15 to 20 ft. from the ship's side, so that operations can be carried out in cases where the vessel has an appreciable list to port or starboard. In addition, most large liners of the present day are provided with either electric or hydraulic boat winches to enable the falls to be quickly operated. These winches, when electric, can be, and very often are, capable of being run off the emergency generators or batteries which are now compulsory by B.O.T. regulations in all vessels carrying over a certain number of passengers.

"Torpedoed" quite rightly calls attention to the need of properly trained men to work the important electrical installations on board ship, without which all the safeguards in the world are of little avail. The B.O.T. certificates will in the future undoubtedly call for a thorough electrical training, as on a Diesel ship the electrical knowledge required is at least as necessary and important as the purely mechanical. Apart from this, I think that the real cause of the trouble is that owing to the relatively rapid rate at which electricity has developed in the mercantile marine the old type of ship's electrician has been left behind. He is unfortunately very often merely a "wireman" or "wire slinger," and although he would very probably designate himself an electrician he has had no bench training at all and has little or no mechanical knowledge. He is quite capable of tracing a fault, renewing a lamp, or wiring up additional fittings and motors, but is quite incapable of quickly diagnosing the troubles in modern distant-control apparatus or carrying out efficient repairs on board to motors and contactor gear. This is not his fault. It is simply that he has not had the opportunities during his apprenticeship of getting familiar with the construction of this apparatus, or of learning electrical fitting work. It is quite likely that his early training has been confined to house wiring, with perhaps a little ship's wiring before being taken on as an electrician on an important liner. The result is that the apparatus is always going wrong and the repair bill is much higher than it should be. To remedy this state of affairs a capable electrical engineer is required on the staff of the engineering superintendent who can choose the right sort of men as electricians and see that the installations are maintained in a proper manner. The number of steamship companies which have so far adopted this policy can be counted on the fingers of one hand, but these companies are undoubtedly reaping the benefit of their wisdom.

Ultimately superintendent engineers will require to have the same specialised knowledge as the large generating-station engineers, but this is a matter of growth, and the old order of things cannot be changed in a day.

W. Saker.

October 7th, 1923.

Working Conditions in America.

Could any of your readers furnish me with any information as to the conditions and salaries of electricians and armature winders in America at the present time, and if there is a surplus or otherwise of these? Also the conditions of living compared to those here?

Erimus.

October 6th, 1923.

An Improvised Oven.—An unusual application of electric heating was made recently when electrically-roasted beef was served to 5,000 people at an annual function at Ephrata, Washington, U.S.A. According to the *Electrical World*, four steers, weighing about 2,000 lb. each, were dressed, prepared, and roasted in a large electrically-heated pit built in the ground especially for the occasion. The improvised oven was 32 ft. long, 4 ft. wide, and 6 ft. deep. Twelve heating elements, each of 3-kW capacity, and consisting of about 150 ft. of No. 14 iron wire, were placed 1 ft. above the bottom of the pit. Sheet-iron heat deflectors were placed 1 ft. above the heating elements, and 1½ ft. above the deflectors were placed iron bars to carry the beef. Thermostatic control was provided to maintain an even heat in the pit. The meat was first roasted at a temperature of 550 deg. for two hours. The heat was then reduced to 350 deg. and maintained at that temperature for four hours. For the next six hours the temperature ranged from 250 deg. to 300 deg. At midnight the meat had been roasting for 12 hours, and the temperature was then reduced to 200 deg. and held there for 12 hours until the time of the "barbecue." The success of the undertaking was due to Mr. H. I. Kelhm, district manager of the Washington Water Power Co. at Ephrata, who originated the idea and supervised the electrical installation.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents, 285, High Holborn, London, W.C. 1.

23,761. "Receiving apparatus for wireless signalling." D. S. B. Shannon. September 24th.

23,762. "Wireless signalling apparatus." D. S. B. Shannon. September 24th.

23,765. "Electric switches." W. J. Line. September 24th.

23,767. "Wireless aerials." S. Hinchcliffe. September 24th.

23,776. "Crystal detectors for wireless receiving sets." H. Hibbert and S. Rushton. September 24th.

23,779. "Basket coils, &c." J. Webb. September 24th.

23,787. "Electromagnetic sound reproducers." Fuller's United Electrical Works, Ltd., and A. P. Welch. September 24th.

23,788. "Wireless valve holders." E. E. Wright. September 24th.

23,807. "Combined electric inspection lamp, dash-light, and map-holder." L. E. Loveland. September 24th.

23,810. "Combined wireless receiver and gramophone cabinet." H. S. Hydes and F. Meer. September 24th.

23,824. "Device for supplying filament current for radio reception." F. R. Hoyt. September 24th.

23,826. "Thermionic valves, &c." B. H. N. H. Hamilton and B. Williams. September 24th.

23,860. "Aerial conductors for wireless telegraphy, &c." V. I. Bashenoff and J. von Plebanski. September 24th.

23,875. "Magneto-electric machines." W. T. Turner. September 25th.

23,876. "Terminals for electric switches." W. L. Barber and Midland Electric Manufacturing Co., Ltd. September 25th.

23,904. "Electric heating devices." L. C. Baker and E. N. Quance. September 25th.

23,930. "Telephone repeater systems." Western Electric Co., Ltd. September 25th. (United States, September 28th, 1922.)

23,937. "Crystal detectors for wireless receiving apparatus." Burndept, Ltd., C. F. Phillips, and S. F. Woodell. September 25th.

23,942. "Telephone receiver." E. S. Pridham. September 25th. (United States, October 25th, 1922.)

23,954. "Electric lamp holders, wall plugs, &c." D. E. Barnett. September 25th.

23,956. "Methods of working quartz." British Thomson-Houston Co., Ltd. (General Electric Co.). September 25th.

23,988. "Low and high-frequency wiring transfers." G. V. Dowding and K. D. Rogers. September 26th.

23,993. "Electric lamp holders." A. R. Bateman. September 26th.

23,998. "Electric switches, &c." J. B. Tucker. September 26th.

23,999. "Electric switches, &c." J. B. Tucker. September 26th.

24,008. "Variometer coils for wireless telegraphy." C. J. Owen. September 26th.

24,021. "Earthing device for wireless sets." H. Quartermaine. September 26th.

24,032. "Electric testing device." Soc. Fournier et Cie. September 26th. (France, October 3rd, 1922.)

24,049. "Illuminating appliance." A. J. Stephens (W. A. Ingler). September 26th.

24,051. "Switch mechanism for electric light advertisements." H. Hirsch. September 26th. (Germany, September 27th, 1922.)

24,052. "Wireless transmission." C. Bauer. September 26th.

24,083. "Crystal detectors for wireless receiving apparatus." A. Harrison. September 27th.

24,093. "Wireless telegraphy, &c." H. S. Ryland. September 27th.

24,094. "Switches for telephone exchange systems, &c." Western Electric Co., Ltd. (Western Electric Co. Inc.). September 27th.

24,095. "Electron discharge devices." Western Electric Co., Ltd. September 27th. (United States, April 13th.)

24,096. "Electron discharge devices." Western Electric Co., Ltd. (September 27th. (United States, November 20th, 1922.)

24,119. "Electromechanical apparatus for controlling, &c., points for railways, &c." A. Monard. September 27th.

24,129. "Loud speakers for wireless telegraphy, &c." E. E. Rosen and G. Seibt. September 27th.

24,135. "Electric heaters." G. E. Green. September 27th.

24,136. "Electric heaters." G. E. Green. September 27th.

24,138. "Control of electrically-driven reciprocatory apparatus." J. J. Cooper and Underwood Typewriter Co., Ltd. September 27th.

24,139. "Electric motor controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). September 27th.

24,146. "Combined internal-combustion and electric locomotives." Sulzer Frères Soc. Anon. September 27th. (Switzerland, October 11th, 1922.)

24,159. "Electric devices for internal-combustion engines, &c." H. C. Chambers. September 28th.

24,162. "Thermionic valve couplings." A. Dilger, E. B. Homer, and H. Lloyd. September 28th.

24,181. "Wireless, &c., telephone amplifier." A. A. Proudfoot. September 28th.

24,186. "Obtaining radiant electric heat." Grierson, Ltd. September 28th.

24,188. "Wireless apparatus." H. P. T. Lefroy. September 28th.

24,195. "Voltage-reducing apparatus." C. F. Hendrick. September 28th.

24,196. "Electric generators." A. C. Lock and V. J. S. Russell. September 28th.

24,197. "Telephone receivers." R. L. Murray and Telephone Manufacturing Co., Ltd. September 28th.

24,198. "Wireless amplification circuit." C. B. Marks. September 28th.

24,209. "Automatic telephony." P. A. L. Anspach. September 28th. (Belgium, September 30th, 1922.)

24,213. "Electric switches." British Thomson-Houston Co., Ltd. September 28th.

24,214. "Electric lighting systems for motor vehicles." British Thomson-Houston Co., Ltd., and L. Griffiths. September 28th.

24,215. "Electric ship propulsion." British Thomson-Houston Co., Ltd., D. E. Jewitt, and G. O. Watson. September 28th.

24,220. "Wireless transmission." C. Bauer. September 28th.

24,247. "Telephone systems." J. E. Collyer and Coventry Automatic Telephones, Ltd. September 29th.

24,248. "Telephone systems." Coventry Automatic Telephones, Ltd., and C. W. Wilman. September 29th.

24,251. "Wireless receiving set." S. L. Holland and W. A. Pickering. September 29th.

24,254. "Wireless masts." A. D. Lee. September 29th.

24,284. "Wireless crystal detectors." C. E. Hudson. September 29th.

24,298. "Loud speaking telephones." C. M. R. Balbi. September 29th.

24,302. "Means for connecting and bonding metal-covered electric cables to junction boxes, &c." H. Booker. September 29th.

24,309. "Magneto-electric generators for signalling." S. G. Frost. September 29th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

1,217. "Lamp bulbs for vehicle headlights and the like." L. G. Williams. October 10th, 1922. (203,471.)

7,278. "Rotary converters." Forges et Ateliers de Constructions Electriques de Jeumont. April 5th, 1921. (178,090.)

7,332. "Electric switching apparatus and automatic and semi-automatic telephone switching systems." H. Baron (F. Aldendorff). March 13th, 1922. (Cognate application, 15,750/22.) (203,724.)

7,814. "Electrically-propelled motor vehicles." C. J. Gordon. March 17th, 1922. (203,727.)

7,998. "Vapour lamps and the like." R. C. Turner. June 17th, 1922. (203,729.)

9,275. "Electric insulation." W. A. Powell and J. E. Price. March 31st, 1922. (204,068.)

13,343. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. June 14th, 1921. (181,691.)

13,662. "Dynamo-electric machines." J. C. Lincoln. May 13th, 1922. (179,962.)

13,956. "Receivers as used for telephone or like purposes." Automatic Telephone Manufacturing Co., Ltd., S. K. Smith, and F. N. Roseby. May 17th, 1922. (203,748.)

16,050. "Telephone systems employing selecting devices." Siemens Bros. and Co., Ltd., and D. A. Christian. June 9th, 1922. (203,759.)

16,162. "Controlling gear for electric motors." English Electric Co. and L. Rothera. June 10th, 1922. (203,765.)

16,276. "Control mechanism for electric motors and other apparatus." British Thomson-Houston Co., Ltd., and R. D. Given. June 12th, 1922. (203,771.)

16,277. "Control of dynamo-electric machines." British Thomson-Houston Co., Ltd., R. D. Given, and H. W. C. Liddiard. June 12th, 1922. (203,772.)

16,381. "Electric butt-welding machines." A. E. White (Elyria Iron and Steel Co.). June 13th, 1922. (Patent of addition not granted.) (203,781.)

16,382. "Electrical connections between relatively moving conductors." A. E. White (Elyria Iron & Steel Co.). June 13th, 1922. (Patent of addition not granted.) (203,782.)

16,398. "Electric heaters." W. Stubbs and L. Frost. July 13th, 1922. (183,115.)

16,472. "Methods of and means for signalling in wireless telegraphy." L. G. Preston, G. Shearing, and E. J. Grainger. June 14th, 1922. (203,784.)

16,718. "Wireless direction finding apparatus." C. Davis. June 19th, 1922. (203,799.)

16,821. "Dynamo-electric machines." Sir C. A. Parsons and J. Rosen. June 17th, 1922. (203,804.)

17,352. "Couplings for electric ceiling fans." Crompton & Co., Ltd., and H. O. Burge. June 23rd, 1922. (203,814.)

17,436. "Electrically-operated apparatus for advertising or display devices." C. M. Brown and H. G. Cocks. June 24th, 1922. (Cognate applications, 19,403/22 and 25,485/22.) (203,815.)

17,524. "Means for obtaining steady continuous currents." M. I. Pupin and M. C. Spencer. June 26th, 1922. (203,818.)

18,225. "Electric motor control systems." L. Miller, W. Richardson, and Metropolitan-Vickers Electrical Co., Ltd. July 3rd, 1922. (203,829.)

18,480. "Electric resistance switches." Ward Leonard Electric Co., and L. Kebler. July 5th, 1922. (203,830.)

18,893. "Portable electric lamps for use in eye testing." E. Seymour. July 10th, 1922. (203,836.)

19,126. "Apparatus for testing spark plugs and ignition circuits of internal-combustion engines." S. Cooper. July 12th, 1922. (203,838.)

20,116. "Electric hand irons." H. Stand-field-Dodd. July 22nd, 1922. (203,846.)

21,013. "Electrical marine propulsion." A. B. Field and Metropolitan-Vickers Electrical Co., Ltd. August 1st, 1922. (203,861.)

21,604. "Electric switch mechanism." H. A. H. Nijland. August 8th, 1922. (203,865.)

21,999. "Systems for measuring the capacity of electrical circuits." Western Electric Co., Ltd., and D. Nunn. August 12th, 1922. (203,870.)

22,161. "Electric control switches and current regulating means, such as resistances or auto-transformers for use therewith, especially applicable to motor starters." J. A. Hirst and Brook, Hirst & Co., Ltd. August 15th, 1922. (203,872.)

23,141. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). August 25th, 1922. (203,880.)

23,683. "Electromagnetic sound-producing devices." H. Wade (F. J. Kaehni and W. L. Kaehni). August 31st, 1922. (203,885.)

24,052. "Magneto brush and feed oiler attachments for internal-combustion engines." W. Martin. September 5th, 1922. (203,891.)

24,060. "Electric switches." O. Lucas. September 5th, 1922. (203,892.)

26,173. "Electric switches and fuses for use in connection with dynamo-lighting and battery-charging systems of motor vehicles and the like." W. Holt and Brolt, Ltd. September 28th, 1922. (203,916.)

26,217. "Electrically-operated elevators and the like." Metropolitan-Vickers Electrical Co., Ltd. October 10th, 1921. (187,214.)

26,388. "Rotary distributors or commutators for internal-combustion engine electric ignition systems." J. A. Blackburn. September 30th, 1922. (203,918.)

29,078. "Variable electric condenser." C. G. Hill. May 30th, 1922. (197,904.)

29,268. "Electrical ignition apparatus for internal-combustion engines." F. H. Royce and Rolls-Royce, Ltd. October 26th, 1922. (203,939.)

29,768. "Electromagnetic apparatus for operating relay contacts, light signal mechanisms, and for similar purposes." General Electric Co., Ltd. (Hall Switch & Signal Co.). October 31st, 1922. (203,947.)

30,669. "Electrically-operated burglar alarms." M. J. Railing and A. V. Cannon. November 9th, 1922. (203,952.)

31,941. "Manufacture of electric discharge devices." General Electric Co., Ltd., and C. G. Eden. November 22nd, 1922. (203,962.)

34,498. "Electrically-controlled lifts and the like." Waygood-Otis, Ltd. (Otis Elevator Co.). December 18th, 1922. (203,972.)

34,544. "Globe fittings of electric lamps." Veritys, Ltd., and F. W. Thorpe. December 19th, 1922. (203,973.)

34,638. "Electromagnetic receivers." Automatic Telephone Manufacturing Co., Ltd., and S. R. Smith. December 19th, 1922. (203,974.)

1923.

2,807. "Electric distant control system." E. Granat. February 8th, 1922. (193,027.)

3,389. "Methods of and apparatus for starting alternating-current motors." British Thomson-Houston Co., Ltd. (General Electric Co.). February 5th, 1923. (203,984.)

3,528. "Construction of stators for dynamo-electric machines." Ateliers de Constructions Electriques de Charleroi Soc. Anon. May 9th, 1922. (197,666.)

7,131. "Means for exciting and igniting the arcs in metal-vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. March 11th, 1922. (194,724.)